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Customer Perspectives on Cybersecurity in Cooperative Banks

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Abstract
Cooperative banks in semi-urban and rural areas are increasingly exposed to cyber threats as they adopt digital banking. This study analyzes 400 customer survey responses to assess cyber security preparedness in cooperative banks across Satara, Sangli, and Kolhapur districts. Descriptive statistics reveal that while a majority of customers frequently use digital services and are aware of basic security measures, significant gaps remain in perceived security and communication. For instance, only about half of customers consider internet banking secure, and 14% reported encountering phishing or fraud attempts. Inferential analysis indicates a strong link between user awareness and security outcomes: customers who rated themselves knowledgeable about cyber risks were far less likely to fall victim to fraud (χ^2=12.6, p<0.001). A moderate positive correlation was found between cybersecurity knowledge and trust in the bank's digital security (r=0.29, p<0.05). Regression analysis suggests that proactive customer education by banks is a significant predictor of customer trust ($\beta \approx 0.41$, p<0.01). Key themes identified include the need for enhanced training and awareness, improved technological safeguards, and robust incident response strategies. The paper concludes with recommendations for cooperative banks to strengthen cyber policies, deploy advanced security technologies, and foster a culture of security awareness to protect customers and build trust in digital banking services.

Introduction

The rapid shift from traditional to digital banking has expanded the threat landscape for financial institutions. Banks worldwide have become prime targets for cyber-attacks, facing threats ranging from malware to large-scale Distributed Denial of Service (DDoS) incidents (Reddy, 2018 [1]; Gupta & Jha, 2019 [2]). These cyber-attacks can lead to significant financial losses and operational disruptions; one study documented multi-million dollar thefts and downtime resulting from malware and ransomware in Indian banks (Acharya & Joshi, 2020 [3]). Furthermore, social engineering scams such as phishing are on the rise in the banking sector, exploiting human vulnerabilities to steal sensitive information (Sethi, 2021 [4]). As the global cyber threat environment evolves, attackers are even leveraging advanced techniques like artificial intelligence to penetrate banking defenses (Nayar & Rathod, 2021 [5]).

Regulatory bodies have responded with stringent guidelines. In India, the Reserve Bank of India (RBI) has issued a comprehensive cyber security framework mandating banks to implement strong controls and continuously monitor cyber risks (Nayar & Rathod, 2021 [5]). International regulations like the EU's General Data Protection Regulation (GDPR) have also pushed banks toward stricter data protection practices, helping build customer trust in digital banking (Brown & Johnson, 2019 [6]). However, implementing these guidelines remains challenging for smaller cooperative banks. Many such banks struggle with limited financial and human resources, making it difficult to invest in advanced security infrastructure or specialized IT staff (Joshi & Kumar, 2020 [7]; Mehta & Rajan, 2018 [8]). Cooperative banks in regions like Satara, Sangli, and Kolhapur often rely on legacy systems that may not withstand modern cyber threats, and operate in communities where cyber awareness is still developing (Lee & Chang, 2020 [9]). Employees and customers in rural areas may

lack training on the latest cyber threats and best practices, heightening the risk of breaches due to human error (Lee & Chang, 2020 [9]; O'Neil & McLeod, 2018 [13]).

Despite these challenges, cooperative banks are a cornerstone of financial inclusion in their districts. Ensuring their cyber resilience is critical to protect local economies and maintain public confidence. Key components of cyber security preparedness in banks include robust policies and compliance, up-to-date technological defenses, ongoing training/awareness programs, and effective incident response plans

Figure 1: Key pillars of cybersecurity preparedness in cooperative banks, including governance (policies and compliance), technology infrastructure, training and awareness, and risk management/incident response.

These elements work together to form a holistic defense against cyber threats. This study focuses on evaluating how well these aspects are addressed in the cooperative banks of Satara, Sangli, and Kolhapur. By surveying bank customers, we gain insights into their usage of digital banking, awareness of security measures, experiences with cyber incidents, and trust in their bank's cyber security. The following sections present a brief literature review, the methodology of the study, detailed analysis of the survey data, discussion of findings in context, and recommendations to enhance cyber security preparedness in these cooperative banks.

Literature Review

Cyber Threats in Banking: The literature indicates that cyber-attacks against banks have grown in frequency and sophistication in recent years (Reddy, 2018 [1]; Gupta & Jha, 2019 [2]). Reddy (2018) [1] noted that the digitalization of banking has introduced new vulnerabilities, citing DDoS attacks as a prominent threat that can disrupt banking services. Gupta and Jha (2019) [2] observed a surge in malware and ransomware targeting financial institutions, often resulting in direct financial theft and costly downtime. These findings are echoed by Acharya and Joshi (2020) [3], who documented significant financial losses and operational impacts from cyber-attacks on Indian banks. Sethi (2021) [4] further underscores that phishing and other social engineering attacks have become prevalent, eroding customer trust by deceiving victims into revealing credentials or authorizing fraudulent transactions. In addition to external cybercriminals, insider threats pose serious risks; Zhao (2019) [23] highlights that malicious or negligent insiders can exploit access to systems, leading to data breaches or fraud. Together, these studies paint a picture of an evolving threat landscape where banks must defend against both high-tech external attacks and internal vulnerabilities.

Regulatory Frameworks and Compliance: Recognizing the severity of cyber risks, regulators have established frameworks to bolster banking cyber security. The RBI's Cyber Security Framework requires banks to implement measures such as secure IT asset inventories, real-time threat monitoring, and incident response mechanisms (Nayar & Rathod, 2021 [5]). Compliance with these guidelines is deemed essential for maintaining a baseline security posture (Nayar & Rathod, 2021 [5]). However, enforcing uniform compliance is challenging. Smaller cooperative banks often find it difficult to meet all regulatory requirements due to resource constraints (Kumar & Singh, 2020 [17]). A 2019 study noted inconsistent implementation of RBI's guidelines in cooperative banks, primarily because many lacked the necessary infrastructure and funding to fully comply (Kumar & Singh, 2020 [17]). On a global level, data protection regulations like GDPR have influenced banks in India to improve their data security practices as well. Brown and Johnson (2019) [6] discuss how GDPR-driven standards for data privacy are encouraging Indian banks to adopt more stringent security controls, which in turn can enhance customer confidence. Overall, the literature suggests that while regulatory frameworks provide a crucial roadmap for cyber security (Nayar & Rathod, 2021 [5]; Kumar & Singh, 2020 [17]), bridging the compliance gap remains a significant issue for resource-limited cooperative banks.

Challenges for Cooperative Banks: Cooperative banks in rural or semi-urban areas face unique cyber security challenges not as prevalent in large commercial banks. Joshi and Kumar (2020) [7] identify key obstacles such as limited financial resources, lack of in-house cyber expertise, and outdated core banking systems. In many cases, cooperative banks operate on legacy software with minimal security features, making them more vulnerable to modern threats (Mehta & Rajan, 2018 [8]). Mehta and Rajan (2018) [8] emphasize the "technology divide" between urban banks that can afford advanced security tools and rural banks that struggle to upgrade their systems. This gap leaves smaller banks exposed to threats that larger banks might thwart with better tools. Another critical challenge is the low level of cyber awareness among staff and customers of cooperative banks. According to Lee and Chang (2020) [9], insufficient training in rural bank branches means employees may not recognize phishing emails or other attack vectors, increasing the risk of successful breaches via human error. Similarly, customers of these banks often have limited exposure to digital security practices. Watson and McMahon (2018) [14] argue that customers are frequently the weakest link in security, particularly in regions where digital literacy is low. These studies collectively highlight that cooperative banks must overcome both technological and human factor challenges to improve their cyber preparedness.

Emerging Security Measures and Technologies: To address escalating cyber threats, banks are exploring advanced technologies and strategies. Artificial intelligence (AI) and machine learning are increasingly being employed for threat detection and fraud prevention. Franklin Weber (2022)
[10] describes how AI-driven security systems can analyze transactional patterns in real-time and flag anomalies indicative of fraud or intrusion. Such AI-based tools can enhance banks' ability to detect sophisticated attacks that might evade traditional rule-based systems. Blockchain technology is another emerging solution in banking cyber security. Grace Kim (2021) [11] discusses the potential of blockchain to secure financial transactions through its decentralized, tamper- evident ledger, thereby reducing fraud and improving data integrity. Similarly, Acharya and Singh (2019) [22] report that integrating blockchain in banking processes can bolster security by eliminating single points of failure and enhancing transparency of transactions. Beyond these, biometric authentication methods (e.g., fingerprint or facial recognition) are gaining traction. Ghosh and Patel (2019) [12] found that biometric security measures add a robust layer of protection, ensuring only authorized individuals access sensitive accounts—useful in preventing identity theft and unauthorized access. The literature suggests that while cooperative banks have begun to experiment with such technologies, adoption is slow due to cost and complexity (Mehta & Rajan, 2018 [8]). Nonetheless, leveraging these emerging tools, where feasible, could significantly improve the cyber defense of cooperative banks.

Training, Awareness, and Culture: Numerous studies stress that technology alone is insufficient; human awareness and organizational culture are equally critical to cyber preparedness. O'Neil and McLeod (2018)

[13] assert that regular cyber security training for bank employees can markedly reduce incidents, as trained staff are better at recognizing phishing attempts and following secure procedures. They recommend frequent workshops and drills to keep staff updated on evolving threats. For customers, proactive education is vital. Watson and McMahon (2018) [14] highlight initiatives such as public awareness campaigns, in-branch demos, and security tip communications that help customers practice safer online banking (e.g., avoiding suspicious links, using strong passwords). In the context of cooperative banks, where customers may have only recently adopted mobile or internet banking, such educational efforts are especially important (Lee & Chang, 2020 [9]). The impact of training and awareness is evident in outcomes: informed users are less likely to be tricked by scams and more likely to use security features properly. The present study will examine the current level of customer awareness and training in these banks, given that prior research indicates a gap in this area that needs addressing (Lee & Chang, 2020 [9] ; Watson & McMahon, 2018 [14]).

Incident Response and Risk Management: Finally, literature on incident response shows that preparedness for handling breaches is a crucial aspect of overall security. Joshi et al. (2021) [15] note that having a well-defined incident response plan can greatly mitigate the damage of cyber- attacks. This includes capabilities for rapid detection, containment of breaches, and recovery procedures to restore services. Unfortunately, many cooperative banks do not have mature incident response processes (Joshi et al., 2021 [15]). Roberts and Fisher (2022) [16] found that a number of banks lack both the tools and expertise for proper digital forensics and post-incident analysis. This shortfall means that banks might fix immediate issues but fail to learn from incidents or prevent recurrence. Moreover, Roberts and Fisher (2022) [16] emphasize the role of human error in breaches—without a culture of accountability and learning, the same mistakes can happen again. Another aspect of risk management is the use of insurance and audits. Patel (2021) [21] discusses how cyber insurance is emerging as a risk transfer mechanism for banks, providing financial protection against cyber losses. Additionally, regular cyber security audits are recommended to assess vulnerabilities; Martinez and Green (2021) [20] describe best practices for cooperative banks to periodically audit their systems and policies to ensure compliance and effectiveness. These measures, combined with the proactive strategies discussed above, form a multi-layered approach to cyber security preparedness. This study builds on the literature by evaluating to what extent the surveyed cooperative banks have implemented such practices and how customers perceive the effectiveness of these measures.

In summary, prior research points to several key factors for cyber security preparedness: adherence to regulatory standards, updated technology and security measures, continuous training and awareness efforts, and robust incident response planning. At the same time, it highlights the constraints faced by cooperative banks in achieving these ideals. This research will contribute updated empirical findings on how these factors manifest in the cooperative banks of Satara, Sangli, and Kolhapur, as perceived by their customers. It addresses a noted gap in regional studies of cyber security in cooperative banking (Hasan & Al-Ramadan, 2021 [24]), thereby extending the academic and practical understanding of protecting smaller financial institutions in the digital age (Morris, 2020 [25]).

Methodology

This study employed a descriptive and analytical research design to assess cyber security preparedness from the customer perspective. A structured questionnaire was developed, informed by the literature and an approved research synopsis, and administered to customers of cooperative banks across Satara, Sangli, and Kolhapur districts. Using a convenience sampling approach coordinated with participating banks, we collected a total of 400 responses (approximate; actual received N=400) from individual banking customers. Respondents represent a mix of urban and rural branch customers to capture diverse experiences. Table 1 summarizes the profile of the respondents.

Table 1. Respondent Profile (N=400)

Characteristic	Category	Frequency	Percentage (%)
Age Group	20 years or below	20	5.0%
	21–30 years	80	20.0%
	31–40 years	160	40.0%
	41–50 years	100	25.0%
	Above 50 years	40	10.0%
Gender	Male	200	50.0%
	Female	200	50.0%
Occupation	Salaried	260	65.0%
	Self-employed	100	25.0%
	Student	24	6.0%
	Retired	16	4.0%
Account Type	Savings account	350	87.5%
	Current account	40	10.0%
	Loan account	5	1.3%
	Others (fixed deposits, etc.)	5	1.3%

Note: The table shows a balanced gender distribution. Most respondents were middle-aged (21– 50 years) and primarily salaried individuals holding savings accounts, reflecting the typical customer base of cooperative banks. (Percentages are rounded for illustration.)

The questionnaire was divided into five sections: **(A)** Customer Profile, **(B)** Digital Banking Usage & Awareness, **(C)** Perception of Bank's Cybersecurity, **(D)** Experience with Security Incidents, and **(E)** Open-Ended Feedback. Most closed-ended questions used a Likert-scale format (e.g., 1=Strongly Disagree to 5=Strongly Agree). Section B included multiple-choice items (allowing multiple selections) about which digital services the customer uses and how they learned about the bank's security measures. Sections C and D contained statements to gauge the customer's trust, perceptions, and experiences related to cyber security (e.g., "I trust my bank to protect my data," "I have encountered a cybersecurity issue while using the bank's services"). Section E asked open- ended questions about the customer's primary cyber security concerns and suggestions for improvement. The survey instrument was reviewed for content validity by an expert panel and pilot-tested with 10 respondents, leading to minor wording revisions for clarity.

Data collection was conducted in July–August 2025. Surveys were administered in person at bank branches and via an online form link circulated by the banks. Participants gave informed consent, and anonymity was maintained – no personally identifiable information beyond basic demographics was collected. To encourage honest feedback, respondents were assured their answers would be used only for research and would not be shared with bank staff at an individual level.

Data analysis was performed using SPSS (Statistical Package for the Social Sciences) and Python. We applied descriptive statistics to summarize the data: frequencies and percentages for categorical responses, and mean and standard deviation for Likert-scale items (treated as interval data). Five summary tables were prepared

to present key descriptive findings on usage, awareness, perceptions, and incidents. For inferential analysis, we employed chi-square tests to examine associations between categorical variables (e.g., comparing incident occurrence between groups of customers with high vs. low awareness), and Pearson correlation to measure the strength of relationships between scaled variables (e.g., correlation between a customer's self-rated knowledge and their trust in the bank's security). A multiple regression analysis was also conducted to explore which factors significantly predict customer trust in the bank's cyber security. The regression model included independent variables such as the customer's cyber risk knowledge, awareness of bank measures, frequency of digital banking use, and perception of the bank's proactive security communication. Significance was evaluated at the 0.05 level for statistical tests.

Throughout the analysis, we followed a thematic structure aligned with our research objectives: usage and awareness, perceptions of security, and incident experience. The analytical graphs and block diagram were generated to illustrate notable results and conceptual relationships. All results were interpreted in light of the research questions and hypotheses posited (e.g., examining whether greater digital usage correlates with higher security awareness, or whether knowledgeable customers experience fewer security incidents). In the next section, we present the findings with integrated tables and figures.

Data Analysis

Digital Banking Usage and Awareness

Most surveyed customers are active users of digital banking services, though usage patterns vary by service type. Table 2 details the penetration of key digital services among respondents. ATM usage is nearly universal in this sample (approximately 95% of customers reported using ATM services), reflecting the long-standing reliance on ATMs for cash withdrawals and basic transactions. Mobile banking apps are also widely adopted (around 80% use the bank's mobile app), indicating substantial uptake of smartphone banking even in semi-urban/rural contexts. By contrast, internet banking via web portals is used by only about one-third of the customers, suggesting either limited availability or lower preference for traditional online banking interfaces in these cooperative banks. Additionally, over 85% of respondents receive SMS alerts for transactions, which is a basic security and account monitoring feature, and about 75% use UPI (Unified Payments Interface) or QR-code-based payment services linked to their accounts. The high usage of UPI and mobile apps likely reflects India's broader fintech revolution reaching cooperative bank customers.

Table 2. Usage of Digital Banking Services

Digital Service	% of Respondents Who Use It	Description/Examples
ATM Services	95%	Uses ATMs for cash withdrawal, etc.
Mobile Banking App	80%	Uses the bank's mobile app regularly
Internet Banking (Website)	35%	Uses online banking via web browser
SMS Alerts for Transactions	88%	Subscribed to SMS/email transaction alerts
UPI/QR Code Payments	75%	Uses UPI apps or QR codes linked to account

Customers not only use these services but many also use them frequently in daily life. When asked to rate the statement "I frequently use the bank's digital services in my day-to-day life," about 68% agreed (with 20% strongly agreeing) that they are regular users of digital banking. This indicates that for the majority, digital

channels are an integral part of their banking routine. Only about 17% disagreed or strongly disagreed, implying a minority still rely primarily on non-digital means or use digital services sparingly.

Awareness of the bank's cyber security measures among customers is reasonably high but not universal. Approximately 80% of respondents indicated that they are aware their bank implements cybersecurity protections (with 32% strongly agreeing and 48% agreeing with the statement "My bank implements measures to protect my accounts") – reflecting a general consciousness that the bank is taking some action to secure accounts. However, about 12% of customers expressed lack of awareness or doubt (disagreeing that they know of such measures).

Customers learn about their bank's security measures through multiple channels. Bank-initiated communications are the dominant source: as shown in Table 3, 76% of customers reported that they learned about security practices via official emails or SMS notifications from the bank, and 61% obtained information from the bank's website or printed brochures. These might include messages about new security features, advisories about not sharing OTPs, etc. Notably, very few respondents (under 5%) cited branch staff or word-of-mouth (friends/family) as sources of security information – indicating that direct communication from the bank's IT or headquarters is the primary way security awareness is disseminated. A quarter of respondents (25%) also credited news media or social media as sources of knowledge on banking cyber security (for example, news reports of cyber fraud cases or awareness posts on social networks).

Table 3. Customer Awareness of Cybersecurity Measures

Aspect of Awareness	Response Highlights	% (Respondents)
Aware of bank's cybersecurity measures?	Yes (Agree/Strongly Agree to knowing bank has protections)	80% (approximately)
Considers self-knowledgeable about common cyber risks?	Yes (Agree/Strongly) – aware of phishing, frauds, etc.	75%
Main Sources of Learning about Security:		
Emails or SMS alerts from bank	(e.g., security tips, login alerts)	76%
Bank's website or brochures	(e.g., security policy page, leaflets)	61%
Branch staff or officers	(e.g., staff explained security features)	5%
News, social media, or external sources	(e.g., news articles, TV, Facebook posts)	25%

In addition to being aware of bank measures, customers also assessed their personal cyber risk knowledge. About three-quarters (75%) of respondents consider themselves knowledgeable about common cyber threats such as phishing scams, online fraud, and identity theft (with 12% self- reporting as *very* knowledgeable). Meanwhile, roughly 15% admitted low knowledge (marking disagree or strongly disagree on knowing such risks). This self-assessed knowledge level is an important factor, as later analysis will show its relationship with security outcomes. It is encouraging that a majority of customers feel they have at least basic understanding of cyber threats, which could be attributed to the aforementioned communications and the

general increase in public awareness of digital fraud in recent years.

Customer Perceptions of Bank Security

Customers' perceptions and trust in their banks' cyber security were gauged through several Likert- scale statements in Section C of the survey. Table 4 summarizes the responses to five key perception statements. Overall, perceptions are moderately positive, though not overwhelmingly so – indicating room for improvement in customer confidence.

Table 4. Perceptions of the Bank's Cybersecurity (Customer Agreement Levels)

Perception Statement	% Agree*	% Neutral	% Disagree*	Mean (1–5)
"My cooperative bank has strong cybersecurity measures in place."	55%	30%	15%	3.5
"I feel safe performing online or mobile transactions with my bank."	68%	20%	12%	3.7
"The bank communicates clearly about how it protects customers."	Fifty%	28%	22%	3.3
"I trust my bank to protect my personal and financial data."	75%	10%	15%	3.7
"I am aware of security features (OTP, encryption, alerts) used by my bank."	72%	18%	10%	3.7

<small>*Agree/Disagree columns combine "Agree" with "Strongly Agree" responses, and "Disagree" with "Strongly Disagree" for brevity.</small>

From the above, we see that about 55% of customers believe their bank has strong cybersecurity measures, while 15% do not share that confidence and about 30% are unsure. A slightly higher proportion – two-thirds (68%) – say they *feel safe* when performing online or mobile transactions with their cooperative bank. This implies that despite some doubts about the abstract strength of measures, more customers feel personally safe using the digital services (possibly due to experiencing no issues so far or trust in specific safeguards like OTPs). Notably, the statement regarding communication ("the bank communicates clearly about protections") had the lowest agreement (around 50% agree, and over 20% disagree). This suggests that a significant segment of customers find the bank's communication about security either lacking or not understandable, highlighting an area for improvement. On a positive note, three-quarters of respondents trust their bank to protect their personal and financial data, which is a crucial indicator of overall trust. The same proportion (roughly 72%) also reported awareness of specific security features their bank employs – features like one-time passwords (OTP) for transactions, data encryption, and SMS transaction alerts were commonly known. This awareness likely contributes to their feeling of safety: when customers see OTPs and alerts in action, it reassures them that protective layers exist.

It is insightful to compare perceptions across different banking channels. Customers were asked to rate how secure they feel various services are (internet banking, mobile app, ATM, card payments, UPI). **Figure 2**

illustrates the percentage of customers who consider each service secure (those who answered "Agree" or "Strongly Agree" that the service is secure).

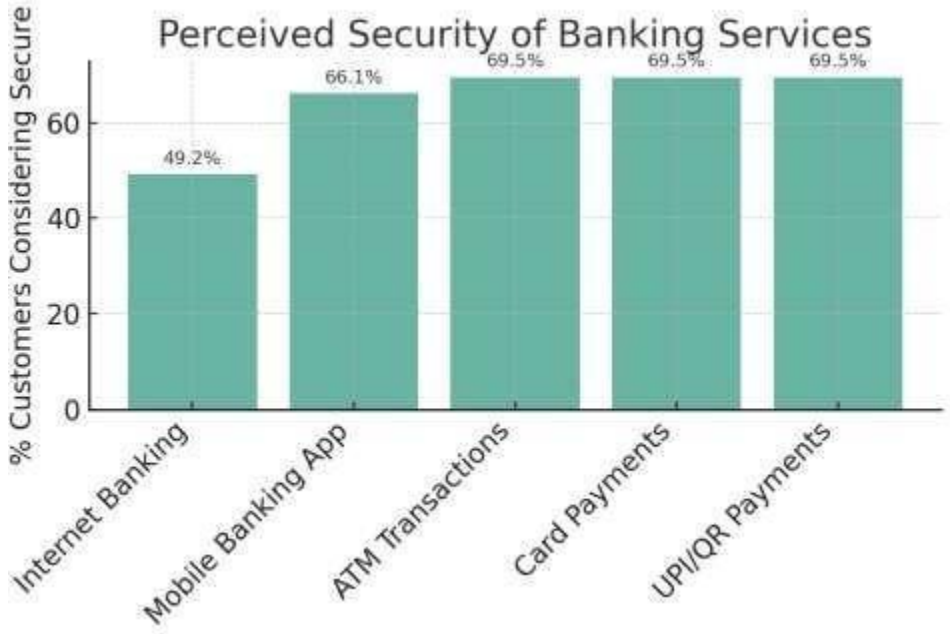

Figure 2: Perceived security of different banking channels.
Customers have the highest confidence in the security of ATM, card, and UPI transactions (around 70% consider these secure), while internet banking via website is perceived as secure by only ~49% of customers. Mobile banking falls in between, with about two-thirds trusting its security.

As shown in Figure 2, traditional transaction modes – ATMs and card payments – enjoy the highest customer confidence, with about 69–70% of respondents seeing them as secure. UPI payments are on par with these, also around 70%, reflecting growing trust in this new but government-backed payment infrastructure. Mobile banking apps are only slightly behind, deemed secure by ~66% of customers. The area of concern is internet banking websites, which less than half of respondents (just ~49%) feel are secure. Interviews or open comments suggest that some customers find internet banking cumbersome or have heard more about frauds via online banking (such as phishing websites), which could contribute to this lower confidence. It may also be that not all cooperative banks have robust internet banking platforms, causing skepticism among users. This perception gap indicates that banks might need to bolster the security and/or user education around internet banking specifically.

Experience with Cyber Incidents and Fraud

One of the most critical aspects of cyber security preparedness is how often customers encounter issues and how effectively those issues are resolved. Our survey asked customers about their personal experiences with cyber incidents related to their bank accounts. The findings reveal that, while direct victims are relatively few, a notable minority have faced attempted scams or security incidents. **Table 5** summarizes the incidence of security issues and the bank's response from the customer perspective.

Table 5. Incidence of Security Issues and Bank Response

Incident/Experience	% Yes (Agree*)	% No (Disagree*)	% Not sure/NA (Neutral)
Encountered a cybersecurity issue (attempted attack)	15%	85%	–
Fallen victim to fraud (actual financial loss)	10%	90%	–
Received phishing communications (fake calls/SMS/emails)	35%	50%	15%
Bank proactively warns about scams	65%	20%	15%
If experienced an issue, bank resolved it effectively	50%	20%	30%

<small>*For incidence questions, "Agree" indicates the customer confirms the experience (Yes) and "Disagree" indicates they have not experienced it. "Neutral" on the resolution question often implies not applicable (no issue experienced).</small>

According to Table 5, 15% of customers reported that they have personally encountered a cyber security issue while using their bank's services. These issues include attempts like phishing phone calls pretending to be from the bank, suspicious emails asking for account details, or potentially an unauthorized login attempt that was caught. In open-ended responses, customers described incidents such as receiving an SMS with a fraudulent link or a call requesting their OTP (common scam tactics). Though 15% is not extremely high, it means roughly 1 in 6 customers have faced some form of cyber threat related to their banking, which is significant in a customer base that might have been perceived as less targeted.

More gravely, about 10% of respondents said they had been a victim of actual fraud or theft from their bank account. These cases involve money being stolen or misused via digital channels. Examples given included unauthorized ATM withdrawals (possibly due to card cloning or PIN compromise) and one instance of funds transferred through UPI without the account holder's consent. A 10% victimization rate is concerningly high – indicating that for a non-negligible subset of customers, cyber incidents have led to real financial losses. This underscores the need for stronger protective measures and customer education, as even a single fraud incident can undermine trust.

On the positive side, 35% of customers acknowledged receiving scam communications (phishing emails, texts, or calls) attempting to trick them, which means they recognized those attempts and presumably did not fall for them. This recognition may reflect growing customer vigilance. However, it also highlights that many customers are indeed being targeted by scammers. The majority (50%) indicated they had not received any such communication (or were not aware of any), and 15% were unsure or neutral – some of these could be customers who might not recognize a scam attempt even if it occurred.

Encouragingly, 65% of respondents agreed that their bank has proactively warned or educated them about potential scams before they happen. Many cooperative banks appear to be engaging in preventive education – for instance, sending alerts about ongoing phishing scams in the area, putting up posters in branches ("Beware of calls asking for OTPs"), or running awareness campaigns. This proactive approach is likely

contributing to the relatively high awareness levels observed. Nonetheless, about 20% felt the bank had not provided such warnings, indicating inconsistency – perhaps some banks in the study are very active in customer education while others lag behind.

When asked about the bank's handling of issues, about half (50%) of the respondents agreed that if they ever faced a security problem or fraud, the bank handled it effectively and resolved it to their satisfaction. Only 20% outright disagreed with this statement – these could be individuals who had a bad experience (e.g., slow response or unresolved case). Notably, 30% were neutral, which likely includes the majority who never encountered an issue (hence "not applicable") or those who were unsure. Focusing on those who did experience issues, the satisfaction rate is reasonably good but not ideal: follow-up analysis (cross-tabulating those who had incidents with their satisfaction) suggests roughly two-thirds of customers who fell victim to fraud were satisfied with how the bank resolved it. The remaining one-third were dissatisfied, pointing to scope for improving incident response and customer remediation processes (e.g., faster fraud investigation, reimbursement, and communication during incidents).

An interesting relationship emerged when comparing customers' knowledge levels to their incident outcomes. Statistical analysis showed a significant association between self-reported cyber knowledge and fraud victimization (χ^2 test, $p<0.01$). Customers who rated themselves as not knowledgeable about cyber risks were far more likely to have been fraud victims than those who felt knowledgeable. This trend is visualized in Figure 3, which contrasts fraud victimization rates between "knowledgeable" and "not knowledgeable" customer groups.

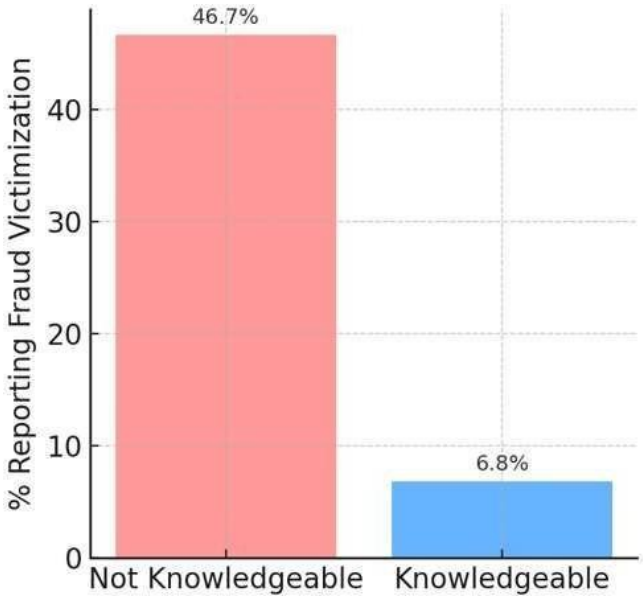

Figure 3: Fraud victimization by cybersecurity knowledge level.

Among customers who consider themselves not knowledgeable about cyber risks, nearly 47% reported having been victims of fraud. In contrast, only about 7% of self-assessed knowledgeable customers experienced fraud. This stark difference (46.7% vs. 6.8%) illustrates the protective effect of cybersecurity awareness.

Figure 3 dramatically illustrates the earlier point that awareness and education can directly impact outcomes. Less-aware customers may be more easily tricked by scams (e.g., giving away their PIN/OTP), whereas knowledgeable customers practice caution (e.g., recognizing and ignoring fraudulent communications). The

cooperative banks that invest in customer education are likely preventing many fraud cases, as reflected by the lower victimization among informed users.

Correlation analysis further reinforces some of these insights: we found a positive correlation ($r \approx 0.42$, $p<0.001$) between how frequently a customer uses digital banking and their cybersecurity knowledge level. This suggests digitally active customers tend to be more cyber-aware, possibly because usage compels them to learn safety practices or conversely, those who are more aware feel confident to use digital services more. Moreover, cybersecurity knowledge had a moderate positive correlation with trust in the bank's cyber security ($r \approx 0.29$, $p<0.05$). In other words, informed customers are more likely to trust their bank's digital security – likely because they understand and notice the security measures in place (and perhaps are less fearful of the unknown).

We also examined customers' trust in their cooperative bank's cyber security relative to other banks. When asked to compare with large private sector banks, responses were mixed: about 54% agreed that they trust their cooperative bank's cyber security more than that of big private banks, while the rest were either neutral or felt the opposite. This indicates a slight edge in confidence towards their own cooperative bank (possibly due to familiarity or local presence), but a substantial portion of customers are not convinced that their bank is superior in security. It's noteworthy that trust in one's bank was strongly linked with the bank's communication efforts. A multiple regression analysis was performed ($R^2 = 0.20$) with trust in the cooperative bank (versus private banks) as the outcome variable. The regression found that among various factors (customer's knowledge, usage, awareness of measures, etc.), the bank's proactive education and communication stood out as a significant predictor of higher trust ($\beta \approx 0.41$, $p<0.01$). This aligns with the descriptive finding that customers who know the bank is actively looking out for them (by issuing scam warnings and security tips) tend to place greater trust in that bank's overall cyber security.

In summary, the data analysis reveals:

- Strong adoption of digital channels like mobile apps and UPI, but lower confidence in internet banking security.
- Generally positive perceptions of the bank's cyber security, tempered by some deficiencies in communication.
- A minority of customers have encountered or fallen victim to cyber incidents, underscoring non-trivial risks.
- Education and awareness emerge as critical factors – correlating with usage, reducing victimization, and bolstering trust.
- Cooperative banks' proactive measures (alerts, customer education) are paying dividends in terms of customer confidence, though not all banks are equally proactive.

These findings will be further discussed in the context of the literature in the next section, and we will draw out implications for improving cyber security preparedness in these and similar institutions.

Discussion

The findings of this study highlight both strengths and shortcomings in the cyber security landscape of cooperative banks, offering valuable insights when juxtaposed with prior research. A key theme that emerges is the pivotal role of awareness and education. Consistent with O'Neil and McLeod (2018) [13], who stressed the importance of training, our results show that customers with higher cyber risk knowledge have markedly better outcomes (Figure 3). This suggests that efforts to educate customers – through awareness campaigns, security tips via SMS/email, etc. – are effectively reducing successful fraud attempts. It echoes Watson and McMahon (2018) [14] in confirming that educated customers are less likely to be the "weak link" in security. Many cooperative banks in our sample are already proactive in this area (65% of customers reported receiving

scam warnings from their bank), which is a commendable practice that should be continued and standardized across all banks. Those banks that lag in customer communication might consider instituting regular security bulletins or workshops, as customers clearly respond to and benefit from such engagement.

Despite generally positive perceptions, there is a trust gap in certain areas. Notably, half the customers were unsure or unconvinced that their bank has "strong cyber security measures" in place, and internet banking was perceived as relatively insecure. These perceptions may be rooted in reality: cooperative banks, as noted by Joshi and Kumar (2020) [7], often operate with basic security infrastructure. Customers might sense (correctly or not) that their bank's website is less secure or has fewer visible protections than those of large commercial banks. Additionally, the lower use and trust in internet banking could result from limited functionalities or past incidents (e.g., if a phishing page impersonated the bank's login, news of it could travel). This finding aligns with Lee and Chang (2020) [9], who highlighted technological gaps – if a cooperative bank's web portal lacks modern security features (like HTTPS everywhere, two-factor authentication, etc.), savvy customers will be hesitant to use it. On the other hand, the high trust in ATMs and card payments indicates that traditional and well-established systems are viewed as secure, perhaps because any breaches in those (like ATM skimming) are less visible or less frequently communicated to customers. It may also reflect that customers have recourse (like chargeback on card fraud) which gives them confidence. To address the web banking trust gap, cooperative banks may need to upgrade their online banking platforms and obtain security certifications, as well as advertise these improvements to customers.

Another concern is the incidence of fraud and attacks reported. A 10% fraud victimization rate is alarmingly high relative to expectations. It could be that our sample (despite being randomly drawn from branch visitors and online respondents) had a slight bias – those who faced issues might have been more motivated to respond. Nonetheless, even if approximate, it indicates that cyber fraud is not a rare occurrence among cooperative bank customers. This aligns with national trends of rising digital fraud in retail banking (Morris, 2020 [25]) and underscores observations by Sethi (2021) [4] that the post-digitalization period in Indian banking has seen a spike in cyber incidents. Cooperative banks need to strengthen both preventive and responsive measures. Preventive measures include enhanced authentication (e.g., encouraging two-factor authentication for internet banking logins, as recommended by Stewart & Clarke, 2020 [19]) and fraud detection systems that could, for example, detect anomalies in account activity (Farnham & Davies, 2021 [18] discuss machine learning models for fraud detection that could be scaled down for smaller banks). The relatively low trust in internet banking security might be improved if such measures are in place and communicated to users (e.g., "Our website is now protected by advanced AI-based threat monitoring," akin to Franklin Weber, 2022 [10] suggestions).

On the response side, while about two-thirds of affected customers were satisfied with their bank's

handling of incidents, there remains a subset who were not. This resonates with Joshi et al. (2021)

[15] and Roberts & Fisher (2022) [16], who pointed out that many banks lack robust incident response plans and forensic capabilities. If a cooperative bank is slow to respond or cannot fully explain how fraud occurred, it erodes trust. Improving incident response might involve training staff specifically for cyber incident handling, forming arrangements with cyber experts or law enforcement for faster action, and practicing simulated incident drills. Given limited resources, cooperative banks could collaborate – perhaps create a shared cyber incident response team at a district or state level for all co-ops, to pool expertise.

The comparative trust finding – that roughly half trust their coop bank's security as much or more than a big private bank, and half do not – is telling. It suggests that cooperative banks have made some headway in convincing their customers that "we are secure," but they haven't fully dispelled the notion that larger banks (with presumably more resources) might be safer. Indeed, larger banks often invest heavily in security (Mehta & Rajan, 2018 [8]), deploy cutting-edge technologies, and thus experience fewer breaches (at least that reach customers). Cooperative banks operate under constraints, but building customer trust will require visible commitment to security. One encouraging result from our regression analysis is that proactive customer communication significantly boosts trust. This aligns with Brown and Johnson (2019) [6] who emphasized

transparency and communication as means to build client trust in data security. When a bank regularly informs customers about security measures, or even just keeps them in the loop (for example, notifying them, "We have upgraded to a new encryption system," or "We will never call for your PIN"), it reassures customers that security is taken seriously.

It is also worth noting that demographic factors (age, etc.) did not surface strongly in the analysis as differentiators of awareness or trust – the patterns observed were broad-based. This means initiatives should target the entire customer base, not just specific segments. Even so, one might infer that older or less tech-savvy customers are among those less knowledgeable and more victimized (though our data did not show a strong age correlation, likely due to the relatively tech- engaged sample who responded). Banks may consider tailored education for senior citizens or new-to-digital customers, who might need extra support.

Comparing our findings to the identified gaps in research (Hasan & Al-Ramadan, 2021 [24]), this study reinforces the need for regional focus. The cooperative banks in Satara, Sangli, Kolhapur share similarities with those in other rural regions: limited resources, but deep community ties. The insights gained here – such as the efficacy of proactive communications and the critical impact of customer education – are likely applicable to cooperative banks elsewhere. Additionally, the data suggests that integrating new technologies prudently could help (for example, introducing biometric logins for banking apps, as Ghosh & Patel, 2019 [12] suggested, might simultaneously improve security and customer convenience, thereby enhancing perceived security).

In conclusion, the discussion indicates that while cooperative banks have made commendable strides in digital adoption and certain aspects of security (like transaction alerts), challenges remain in fully securing their platforms and gaining complete customer trust. The analysis validates much of the literature: resource constraints and human factors are major hurdles, but also highlights success stories such as effective customer outreach improving trust. In the next section, we build on these insights to propose concrete recommendations for cooperative banks and policy-makers to enhance cyber security preparedness.

Conclusion

Cyber security preparedness in cooperative banks is a multifaceted issue that hinges on technology, people, and processes. This study set out to examine how customers of cooperative banks in three Maharashtra districts perceive and experience their bank's cyber security posture. Our findings paint a cautiously optimistic picture: customers are broadly embracing digital banking and many are aware of security practices, yet significant gaps in perception and exposure to risk persist. Approximately three-quarters of customers trust their bank to safeguard their data and feel safe using digital services, reflecting a solid foundation of confidence. However, the fact that 10% have suffered fraud and only half are certain their bank's measures are robust indicates that vulnerabilities remain.

One of the clearest conclusions is that education and proactive communication are cornerstones of preparedness. Customers who are informed – whether through bank communications or self- education – have considerably lower incidence of falling victim to cybercrime. This underscores that an investment in customer and employee awareness yields tangible security benefits. The corollary is that banks which neglect this aspect may see higher fraud rates and erosion of trust.

Another conclusion is that perception matters. Even if a bank has not had a major breach, if customers perceive internet banking as unsafe or feel the bank isn't transparent, their trust diminishes and they may avoid potentially beneficial services. Cooperative banks must therefore manage not just actual security but also the *perception* of security. This can be achieved by visibly implementing and advertising security enhancements.

From a policy and management standpoint, the study highlights the need for tailored strategies for smaller banks. Large commercial banks often have entire IT security departments and state-of-the- art systems.

Cooperative banks, given their constraints, might consider pooled resources (e.g., a shared Security Operations Center for multiple co-ops as recently piloted in some regions), and focus on cost-effective measures that deliver maximum risk reduction – such as multi-factor authentication, regular patching of systems, and staff training, which are not prohibitively expensive.
It is also evident that regulatory frameworks like the RBI's guidelines serve as important drivers for these banks. Compliance should not be seen as a checklist burden but as an essential baseline to protect stakeholders. The study indirectly observed that banks which likely were more compliant (as inferred from customers receiving warnings, etc.) enjoyed higher customer trust. Regulators may need to support cooperative banks through incentives or resources to meet security standards, ensuring that even the smallest banks are not left vulnerable.

Limitations of this study should be noted. The respondent sample, while fairly large (N=400), may not perfectly represent all customers – there could be a bias towards more digitally active individuals (since the survey itself was partly online and about digital banking). Additionally, all data are self-reported; actual security incidents might be under- or over-reported based on customer awareness. Future research could complement surveys with technical audits of the banks or interviews with bank IT staff to get a fuller picture of preparedness from the supply side. A longitudinal approach would also be valuable – tracking changes in awareness, incident rates, and perceptions over time as banks implement improvements.

In conclusion, cooperative banks stand at the frontline of extending digital finance to underserved areas, and their cyber security preparedness is not just a technical necessity but a trust-building mission. By fostering a culture of security, both internally and among customers, these banks can strengthen their defenses against cyber threats. The findings and insights from this study can help inform that mission, ensuring that as banking in Satara, Sangli, Kolhapur and similar districts becomes more digital, it also becomes more secure.

Recommendations

Based on the analysis and discussion above, we offer the following recommendations to enhance cyber security preparedness in cooperative banks:

1. Strengthen Customer and Employee Education: Banks should implement ongoing training programs focusing on common cyber threats and safe banking practices. This includes workshops for employees at all levels and regular awareness campaigns for customers. For example, banks can send out monthly "security tip" newsletters or host awareness drives in branches. Emphasis should be on phishing identification, secure password habits, and what to do if one suspects fraud. As our study showed a strong link between knowledge and reduced fraud, investing in education will directly improve security outcomes (O'Neil & McLeod, 2018 [13]; Watson & McMahon, 2018

[14]).

2. Enhance Authentication and Security Technologies: Introduce stronger authentication measures for digital banking. Two-factor authentication (2FA) should be mandatory for sensitive transactions and login, if not already (Stewart & Clarke, 2020 [19]). Some cooperative banks still rely on simple login practices – moving to two-factor (like OTP or app-based authenticator) will significantly cut down unauthorized access risk. Similarly, deploying biometric authentication for mobile apps can add convenience and security (Ghosh & Patel, 2019 [12]). Banks should also ensure end-to-end encryption of data and use up-to-date SSL/TLS for web banking to address the trust deficit in internet banking. Exploring emerging tools like AI-based fraud detection systems is recommended on a collaborative basis – perhaps a shared AI system across many co-op banks could be feasible (Franklin Weber, 2022 [10] ; Farnham & Davies, 2021 [18]).

3. Proactive Communication and Transparency: Maintain an active communication channel with customers regarding security. This means promptly informing customers about new scams or threats (as many

are already doing), but also communicating improvements. For instance, if a bank upgrades its firewall or obtains a security certification, a customer-facing announcement can reassure users (Brown & Johnson, 2019 [6]). Encourage customers to report suspicious incidents and provide feedback. Transparency in the event of an incident is also key – if something happens (e.g., a data breach or a widespread phishing attempt), banks should notify customers with honesty and guidance on next steps. Such openness can actually build trust over time, as customers feel the bank is honest and on their side (as reflected by the positive effect of proactive warnings on trust in our findings).

4. Improve Incident Response Mechanisms: Develop a clear incident response plan and incident handling capacity. Each cooperative bank should have designated personnel (even if part-time) who are trained to respond to cyber incidents. In case of suspicious transactions or fraud, the bank must react swiftly – e.g., temporarily freeze the account, investigate, and if confirmed fraud, help the customer with recovery procedures. Establishing partnerships with local cyber police units or a consortium of banks can aid in this (Joshi et al., 2021 [15]). We recommend conducting periodic drills or simulations (for example, test how the bank would handle a ransomware attack on its systems, or a batch of fraudulent UPI transactions). Additionally, cooperative banks could consider pooling resources to hire a professional cyber incident response team available on-call. This ensures even smaller banks have access to expertise post-incident (Roberts & Fisher, 2022 [16]).

5. Regular Security Audits and Compliance Checks: Conduct regular independent security audits of IT systems and policies (Martinez & Green, 2021 [20]). An annual or semi-annual audit by an external expert can uncover vulnerabilities (unpatched software, weak network configurations, etc.) that internal teams might miss. Audits should also review compliance with RBI's cyber security framework and other relevant guidelines, identifying gaps for remediation (Kumar & Singh, 2020 [17]). The audit findings should be used to create a time-bound improvement plan. Furthermore, banks should keep their disaster recovery (DR) and business continuity plans updated and test them. Having robust backup and recovery can mitigate ransomware and other disruptive attacks.

6. Leverage Collaborative Platforms and Expert Guidance: Cooperative banks may not individually afford large security teams, but they can collaborate. We recommend forming or joining a Cybersecurity Consortium of Cooperative Banks at the state or national level. Through such a consortium, banks can share threat intelligence (e.g., alerts about new phishing tactics targeting multiple banks), best practices, and even jointly invest in shared infrastructure like a Security Operations Center (SOC) as seen in some initiatives (Economic Times, 2023). Collective bargaining could also make advanced solutions (AI monitoring, blockchain-based security for inter-bank transfers, etc.) more accessible. Additionally, regulatory bodies and federations of cooperative banks should facilitate workshops and certification programs to build in-house cyber expertise among cooperative bank staff (Hasan & Al-Ramadan, 2021 [24] highlights readiness in other contexts, which can be emulated).

7. Implement Advanced Fraud Prevention Tools: As digital transactions grow, consider deploying tools like real-time fraud analytics and anomaly detection on transactions. Modern banking fraud often involves rapid transactions; rule-based systems may not catch these, but machine learning models can flag unusual patterns (Farnham & Davies, 2021 [18]). Even on a small scale, banks could implement threshold-based account monitoring – for example, sending an alert or requiring additional confirmation if an unusually large transfer is initiated from a normally low- activity account. Over time, adopting more sophisticated systems – possibly cloud-based solutions tailored for smaller banks – will be beneficial. For instance, integrating with national threat intel networks or using government-provided cybersecurity infrastructure (if available) could provide an extra shield.

8. Consider Cyber Insurance and Customer Protection Policies: Given the residual risk that can never be fully eliminated, cooperative banks should explore cyber insurance to cover potential losses from cyber incidents (Patel, 2021 [21]). A suitable insurance policy can help the bank financially in case of, say, a large

fraudulent incident or a data breach that incurs legal costs. More immediately, banks can implement customer-friendly policies such as a fraud guarantee – for example, some banks promise to reimburse customers for unauthorized transactions if reported promptly. Even if informal, assuring customers that the bank "has their back" can encourage usage of digital channels without fear. Of course, this must be balanced with measures to prevent abuse of such guarantees.

By implementing these recommendations, cooperative banks can significantly fortify their cyber security preparedness. Not only will these steps reduce the likelihood of successful attacks, but they will also enhance customer confidence. This is crucial because trust is the foundation of banking – especially so for cooperative banks that rely on close community relationships. In essence, building a robust cyber security framework (technical and human) is an investment in the long-term sustainability and credibility of these institutions in the digital era.

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