Impact of Centralized Blockchain Digital Currency (CBDC): For Financial Inclusion and Sustainability

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ABSTRACT

Purpose: *A central bank Digital currency or Digital rupee or e-Rupee is a legal tender digital form backed by sovereign currency attributed to Nobel laureate James Tobin economist In the year 1980, more than 105 countries were exploring CBDC among 50 countries in the advance phase of digital currency (as per NASCUS tracker) to create an environment for a cashless economy with the Government owned Blockchain Distributed ledge Technology (DLT) along Conventional centrally controlled database structure of Digital Public infrastructure of India Stack technology-driven and 5G digital revolution and innovation to close the gaps in Financial innovation and the financial inclusion, Government of India and RBI has made provision in the legal framework in the RBI ACT 1934, Banking Regulation Act 1949, Finance Act, 2022, The coinage Act,2011, FEMA Act 1999, Information Technology Act, 2000 and Payment and Settlement Act,2007 to expand access to financial services and cashless economy with blockchain technology $1.1 trillion has impact on Indian GDP. RBI has created a Retail transaction in P2P, P2M and wholesale transactions in the secondary market including commercial papers, corporate bonds, and deposit certificates. In contrast, retail transactions stood at 2.73 cores and wholesale CBDC transactions stood at 1329. The tokenization of global illiquid assets is estimated to be$16 a trillion-business opportunity by 2030 (BCG analysis) for the payment system of token-based and account-based for sustainable prosperities and Five C 's FI CBDC approach has created a wide range of Financial Inclusion and to achieve Sustainability Development Goals.*

Methodology: *The research draws upon secondary data from publications such as journals, magazines, websites, and periodicals, in addition to a review of previous conceptual and empirical studies to assess the paper's objectives.*

Result/Analysis: *The implementation of the RBI's CBDC has a substantial impact on reaching the SDGs. It increases prospects for FinTech entrepreneurs while lowering operational expenses as compared to traditional money systems.*

Originality/Value: *The study's significant contribution of 5 C's Approach towards CBDC.*

Social Implications: *The research article will create more insight into digital currency and Financial Inclusion.*

Type of Research: *Descriptive Analysis*.

Keywords: CBDC or Digital rupees; Blockchain Technology; Financial Innovation; India Stack Technology; Secondary Market; RBI and Legal framework; Financial Inclusion; Cashless Economy.

1. INTRODUCTION :

India's Digital Public Infrastructure (DPI) innovation has promoted the inclusive use of digital technology and also bridged digital divides and promoted innovation of the Central Bank Digital Currency (CBDC) for the finance revolution along with the blockchain distributed ledger technology

for achieving Social, Scalability, Security and Sustainability in the financial landscape, blockchain distributed technology wide range of banking and finance actives includes centralized KYC, Cross border payments, capital markets, trade finance, syndication of loan (Bhuvana, R., & Aithal, P. S. (2020) [1], CBDC of RBI is the potential application of permission Blockchain and Distributed ledger technology for supporting the rapidly growing digital economy Handa, S. (2020) [2]. NITI Aayag Blockchain the India Strategy Draft on Discussion Paper Part-1 underlines that Blockchain DLT is seen as a technology with the potential to transform almost all industries and the Economy. A Blockchain can be either a centralized or decentralized distribution ledger in which the centralized identity of participants is known and transactions can be audited and different from Bitcoin of the decentralized network. The CBDCs operate on authorized private blockchain whereas cryptocurrency operates on public (permissionless) blockchain.

Government-related blockchain projects could add $5.1 billion to India's GDP by 2032(As per Forbes India report) and it will influence other central banks, it has the potential to transform the innovative ecosystem in the area of Finance, Banking and payment systems. The first time ICIC bank used blockchain technology for remittance and trade finance as well as KYC, blockchain technology is a distributed ledger Sankaranarayanan, G., & RAJAGOPALAN, K. K. (2020) [3]. Digital assets that are authenticated using blockchain technology have created innovative solutions in Distributed Ledger Technology in Non-Fungible tokens or NFTS/NFT, Central bank Digital Currency, cryptocurrencies, stablecoins and Digital Identity. The Blockchain is like a digital ledger. Every transaction is authorized and authenticated by the owner. The digital ledger works similarly to that of an Excel sheet or a Google spreadsheet, where transactional records are stored after each purchase. However, blockchain is highly secured, and every transaction is matched with the buyer and the seller before the payment is debited or credited.

Table 1: Blockchain Technology Project and its Impact on GDP

Government blockchain project impact on GDP	Year
Overall government-related blockchain project	In 2021 $0.1 billion will be $5.1billion
Digital identity project	By 2032 will be $8.2 billion
Payment and Remittance in projects	By 2032 will be $21.7 billion
Digital asset economy	In 2021 $5 billion it is $262 billion

Source: live Mint

Blockchain-based distribution technology has transformed the financial services provided by the central bank, commercial banks, Initial Public Offers, Stock exchange and Financial inclusion It has provided DeFi (Decentralized finance) with new technology solutions in the area of finance and it has great potential to transform the Finance Industry, Blockchain is a distributed technology increased visibility, transparency, trust and automatic execution of transactions and it allows the rural Indian to access global market (Schuetz, S., & Venkatesh, V. (2020) [4], Blockchain Technology (BCT) adoption in the banking and Finance has transformed digital currency, fraud detection, trade finance, cross border remittances, settlement of payment and credit card (Kulkarni, M., & Patil, K. (2020) [5],Banks invest the most in blockchain technology then other financial institutions because it has numerous impacts that might substantially improve the banking sector. (AMON, A., et al. [5]) Blockchain is a new type of technology defined as a "type of distributed ledger technology (DLT) in which transactions are validated and recorded in the distributed ledger in separate but connected batches known as blocks.

Reserve Bank of India (RBI) played a significant role in creating a digitalized innovative and regulatory ecosystem in financial transactions and Fintech products UPI, AA, e-KYC, Safer lending based on cash flows, e-agreement-mandate and credit bureaus. Reserve Bank of India has launched a CBDC infrastructure for scalability and sustainability The Reserve Bank of India (RBI) set up the Reserve Bank Innovation Hub (RBIH) to promote innovation across the financial sector by leveraging technology and creating an environment which would facilitate and foster innovation in Financial Services and to make finance more inclusion through Central Bank Digital Currency (CBDC), Public Tech Platform (PTP) for Frictionless Credit, Bharat Bill Payment System, Kisan Credit Cards (KCCS),

Digital Dairy loan Disbursement, UPI one world and E- Payment system has brought more sustainability.

Table 2: Impact of Blockchain technology in financial areas

Capital Market	Asset Management	Payment and Remittances	Banking and Lending	Trade Finance	Insurance
Asset servicing Issuance, Sales and trading, Clearing and settlement, Post-trade services and infrastructure, Asset servicing, Custody	Fund launch, Cap table management, Transfer agency in **asset management, Fund administration**	Domestic retail payments Domestic wholesale and securities settlement Cross-border payments Tokenised fiat, stablecoins and cryptocurrency	Credit prediction and credit scoring Loan syndication, underwriting and disbursement Asset col-lateralisation	Letters of credit and bill of lading Financing structures	Claims processing and disbursement Parametrized contracts Reinsurance markets

Sources: Consensys

Reserve Bank of India (RBI) played a significant role in creating a digitalized innovative and regulatory ecosystem in financial transactions and Fintech products UPI, AA, e-KYC, Safer lending based on cash flows, e-agreement-mandate and credit bureaus. Reserve Bank of India has launched a CBDC infrastructure for scalability and sustainability The Reserve Bank of India (RBI) set up the Reserve Bank Innovation Hub (RBIH) to promote innovation across the financial sector by leveraging technology and creating an environment which would facilitate and foster innovation in Financial Services and to make finance more inclusion through Central Bank Digital Currency(CBDC), Public Tech Platform (PTP) for Frictionless Credit, Bharat Bill Payment System, Kisan Credit Cards (KCCS), Digital Dairy loan Disbursement, UPI one world and E- Payment system has brought more sustainability.

Digital Financial Inclusion: Technology makes more Digital Financial inclusion for many underserved populations through blockchain, Digital remittance services, digital wallets of fintech, mobile banking, Account Aggregator (AA), Digital Payment platforms, government initiatives and Fintech innovation Mobile banking is an enabler for digital finance and financial inclusion. After the Demontroization of mobile phone banking and UPI, QR plays a very important role in an inclusive society. The Digital India initiative in Open Network for Digital Commerce, Open Credit Enablement Network (OCEN), and National Payment Corporation of India made a more digitally inclusive Ecosystem. Now Digital Currency initiative pushes more inclusive Rural, urban and Semi-Urban populations towards Digital Financial Inclusion. Digital public infrastructure has a significant impact on the Cost of providing banking services, reduces gaps and brings financial services within reach of the population and growth of the economy. As the Economic Survey 2022-23 pointed out Digital Currency (CBDC) will provide a boost to Digital Financial Services and accelerate financial inclusion, contributing to the GDP and Digital Economy. The Reserve Bank of India and NPCI have made interoperable with UPI-enabled QR codes for CBDC transactions for more financial inclusion and Sustainability.

Table 3: Progress Made in Digital Financial Inclusion in India

Particulars	In Crore(Rupee)/Million
No PMJDY Account	5063
No of RuPay Card Issued	34.36
No BHIM UPI transaction	6440 crore
Digital Transaction	8513

Deposit in Account	2505190
No women Beneficiaries	28.10
No beneficiaries in Rural/Semi Urban	33.81
No MUDRA loan	43.74
MUDRA Loan Sanctioned	25.51
Direct Benefit Transfer(DBT) to Beneficiaries	723
No Mobile Banking user base	80.3 Million
Operative Kisan Credit Card	7.36 crore
Women Owned Business Loan MSME(Neo Growth Report-2023)	2600
Credit O/S to MSME by SCB	22.60 Lakh crore

Sources: Pib. Govt. on Dec 2023 & Banking frontiers.com

Digital India has supported the technology and Fintech advancement in banking digital payment services and Smartphones, the Internet has provided the base for more digital payment, and digital lending has had a significant impact on reducing the credit gap in the MSME and now CBDC retail and wholesale the steps towards achieving a cashless society. Digital payments are a feature of all financial transactions and in a cashless world digital money replaces banknotes and coins Kulkarni, M., & Patil, K. (2020) [6].

Table 4: Digital Innovation and Technology Advancement for Financial Inclusion
The table shows various digital means of financial inclusion

1. Unified payment interface UPI by NPCI
2. Digital India Campaign
3. Jan Dhan Yojana
4. JAM Jandhan- Aadhaar- Mobile
5. Mobile Wallets
6. Digital Payment Apps
7. QR codes
8. The Open Banking –Account Aggregator (AA) to BHIM-UPI
9. Payment Banks

Source: Author

Bharat Broadband Network (BBNL) is a special purpose vehicle (SPV) established to provide digital connectivity in India. It is one of the biggest rural telecommunication projects and the organization is working in collaboration with village-level entrepreneurs (VLEs) to ensure that every village in India is connected with the necessary digital infrastructure. Presently, it is estimated that 37 lakh route kilometres of optical fibre cable (OFC) have been laid, and 1.94 lakh villages have already been covered—this information is on the website pid.gov.in. The BBNL initiative aims to bridge the gap between urban and rural India and provide a platform for connecting the Digital Rupee (CBDC) to the unbanked and rural population in digital payment. The Project will create the digital infrastructure required for digital transactions in the rural area and create e-governance, it is funded by Universal Service Obligation Fund to bring internet and mobile connections to rural parts of India to cover e-banking and to address the Gap in the Digital, socio-economy and for sustainability.

2. REVIEW OF LITERATURE (RELATED WORK) :

The various research work carried out by the researchers in the area of centralized blockchain-based CBDC, Financial inclusion and sustainability. Some of the works have re studied and a summary of each work-related is given.

Table 5: Review of Literature

S. No.	Impact	Reference
1	The study reviews the literature on central bank digital currency (CBDC) to assess its potential in enhancing financial inclusion and combating illicit financial flows driven by poverty and inequality concerns. It explores whether CBDC can improve financial inclusion while mitigating illicit fund flows by considering the possibility of CBDC exacerbating financial exclusion and illicit flows. With technological advancements posing threats to monetary sovereignty, CBDC emerges as a response. It attracts attention from central banks, researchers, and academics as a means to address policy issues and improve the monetary system. Various theories are explored to explain phenomena and predict outcomes. Particularly in emerging markets like Africa, CBDC's impact on financial inclusion and illicit flows is significant. The study concludes that improving financial inclusion and curbing illicit flows via CBDC relies on resolving underlying issues leading to financial exclusion. Recommendations include incorporating anonymity features and monitoring transactions to combat money laundering, terrorism financing, and illicit flows.	Nhavira, J. (2019). [7]
2	This paper investigates factors driving global interest in central bank digital currency (CBDC), specifically examining the influence of sustainable development and cryptocurrency interest. It utilizes Google Trends data and employs two-stage least square regression estimation. Findings reveal a significant positive relationship between global interest in sustainable development and CBDC, as well as between global interest in cryptocurrency and Nigeria's naira CBDC. However, there is a significant negative relationship between global interest in CBDC and Nigeria's naira CBDC. Additionally, a positive relationship exists between global interest in CBDC and China's CNY, while a negative relationship is observed between global interest in cryptocurrency and the Sand Dollar and DCash. This study contributes to the literature by filling the gap in empirically examining the motivating factors behind global interest in CBDC, specifically sustainable development and cryptocurrency.	Ozili, P. K. (2023). [8]
3	The paper explores the concept of central bank digital currency (CBDC) as a potential evolution of money. It highlights the perceived benefits of CBDC, including its potential to provide a more stable unit of account, a more efficient medium of exchange, and a safer way to store value. Despite garnering significant attention from academics and practitioners in recent years, there are still unanswered questions about how central banks can effectively implement CBDC and its potential impacts on a country's financial system. The study employs a combination of text mining and systematic review methods to examine existing literature on CBDC. It aims to address the gaps in understanding regarding the efficient implementation of CBDC and its implications for financial systems. The research methodology involves analyzing and synthesizing relevant literature to provide insights into the current state of knowledge on CBDC. The paper contributes to the existing body of literature by providing a comprehensive review of studies related to CBDC, shedding light on various aspects such as its technological underpinnings, regulatory considerations, and potential economic impacts. Through text mining techniques, the authors identify key themes and trends in the literature, offering valuable insights for researchers, policymakers, and practitioners interested in CBDC. This paper also underscores the importance of further research and analysis in the field of CBDC to address the remaining uncertainties and facilitate informed decision-making by central banks and policymakers. It serves as a valuable resource for scholars and stakeholders	Aneja, ret.al. (2022). [9]

	seeking to deepen their understanding of CBDC and its implications for the future of money and financial systems.	
4	The current article discusses the potential introduction of a Central Bank Digital Currency (CBDC) by the Reserve Bank of India (RBI). The study emphasizes India's significant role in the implementation of CBDC due to its advancements in digital payment technologies. The paper aims to assess the viability of CBDC in promoting financial inclusion in India. It highlights the importance of adapting CBDC design to the evolving economic and financial landscape. The authors employ quantitative regression analysis to identify potential drivers of financial sector efficiency and stability, aiming to measure the impact of CBDC implementation on financial inclusion. Using the Structural Vector Auto-Regression model, the study proposes a framework for building CBDC while considering payment system visibility. The research aims to identify gaps in achieving financial inclusion in India and provide insights for designing CBDC to address these gaps. Additionally, the study seeks to elucidate the role of policymakers in maximizing benefits for consumers through CBDC implementation. The paper underscores the potential role of the RBI in ensuring the smooth implementation of CBDC and highlights trends in the Indian payment system that support the positive implementation of CBDC. Overall, the study contributes to understanding the potential of CBDC in enhancing financial inclusion and its implications for policymakers and consumers in India.	Banerjee, S., & Sinha, M. (2023) [10]
5	The article delves into the burgeoning field of central bank-issued digital currencies (CBDCs), which have garnered substantial interest and are under intense scrutiny due to their potential to revolutionize financial transactions with features like rapid settlement, low fees, accessibility, and automated monetary policies. Despite their promising attributes, CBDCs are still at an early stage of development, with adoption rates varying significantly among nations, some of which have embraced them extensively. Utilizing partial least squares structural equation modelling, the study investigates the complex and nonlinear relationship between key national development indicators and the deployment of CBDCs across 67 countries. The research delves into various factors, including technological, environmental, legal, and economic aspects, influencing the adoption of CBDCs by different countries. The findings reveal several noteworthy associations: a statistically significant and positive correlation between a country's adoption status of CBDCs and its level of democracy and public confidence in governance, along with a negative association between regulatory quality and income inequality. However, no significant relationship is found between CBDC adoption and indicators such as network readiness, foreign exchange reserves, and sustainable development goal rank. The study suggests that highly democratic countries with robust governance structures are more inclined to adopt CBDCs compared to others. Furthermore, the research identifies areas for further investigation and underscores policy considerations essential for facilitating broader adoption of CBDCs. This article contributes to the evolving discourse surrounding CBDCs by shedding light on the multifaceted factors influencing their adoption across different countries. It provides valuable insights for policymakers, researchers, and practitioners seeking to navigate the complexities of CBDC deployment and maximize their potential benefits.	Mohammed, M. A. etal.(2023). [11]
6	The article discusses how the CBDC presents a tremendous chance to further India's FI plan towards universal inclusion. CBDC in token form can be utilized for direct benefit and payment transfer purposes, as each	Kumari, J. M. (2021) [12]

	token has a unique identification number. Currency in Circulation (CIC) to GDP ratio indicates currency usage relative to GDP growth. The cash Management Architecture in India consists of 19 RBI offices scattered around the country that supply notes and coins to cash receptacles known as Currency Chests (CCs), which commercial banks, cooperative banks, and regional rural banks maintain. As of March 31, 2020, 3367 such currency chests were playing an active role in supplying fresh currency to far-flung places and withdrawing filthy notes from all over the country, almost all bank branches are linked to these CCs, and they deposit or withdraw funds as needed. The authors also discussed various cryptocurrencies such as Bitcoin, Ethereum, Ripple, Bitcoin Cash, Litecoin, EOS, Stellar, Cardano, and Neo. IOTA and many other cryptocurrency holders began changing their currencies into fiat currencies.	

3. OBJECTIVES OF THE STUDY :

The purpose of this study is to examine the impact of the RBI Digital Rupee or Digital Currency on sustainability. The primary objectives include:
(1) To Understand CBDC technology.
(2) To Identify several central bank projects involving CBDC.
(3) To emphasize the influence of CBDC on the Sustainable Development Goals (SDGs).
(4) To analyze the legal framework for the implementation of CBDC.
(5) To determine the impact of the pilot study of CBDC on financial inclusion.

4. RESEARCH METHODOLOGY :

The current study is a conceptual study that is based on secondary data as well as relevant articles and official websites, journals, newspapers, books, and reports.

5. FINDINGS AND DISCUSSIONS :

5.1 Digital Transactions and Payment Ecosystem for a Cashless Economy:

RBI with the support of NPCI has prepared a road map for Digital payment and transactions that have strengthened the financial sector and ease of living for the citizens, digital payment modes are Bharat Interface for Money -BHIM-UPI, Immediate Payment Services (IMPS), National Automated Clearing House (NACH), Aadhaar Enabled Payment System (AePS), National Electronic Toll (NETC), debit card, credit card, National Electronic Fund Transfer (NEFT), RTGS, PPI, Bharat Bill Payment System (BBPS), mobile wallets, GST, PMJDY have transformed digital payment ecosystem by increasing Person-to-Person (P2P), Person to Merchant(P2M), Mobile enhanced credit access and Financial Inclusion, the introduction of word cashless economy has got momentum after demonetization, recent trends in technology and support of the government of India (Aggarwal, K et. al 2021) [13]. The Digital India initiative has transformed digital infrastructure and technology adoption and contributed to India's Gross Domestic Product (GDP), with Government initiatives in the area of Digitalization in the payment system rapidly making its roots in small towns (Agarwal, M., & Khatri, M. (2024) [14] as per live Mint 2023 India has payment is 89.5 million transactions were as Brazil (29.2 million), China (17.6 Million), Thailand(16.5 Million) and South Korea (8 Million) transactions, 2022.
Digital Transactions include the total number and total value of digital payment transactions during the last 5 years growth has helped the country to move forward from being cash-dependent to a less cash economy.
Digital payment transactions through digital modes Aadhaar enabled Payment Service (AePS) (Fund Transfers), BHIM Aadhaar Pay, National Electronic Toll Collection (NETC) (linked to bank account), Real Time Gross Settlement (RTGS) payment system, and, for retail payments, the payment products are Unified Payments Interface (UPI), National Electronic Fund Transfer (NEFT), Immediate Payment Service (IMPS), Credit and Debit cards, Prepaid Payment Instruments, National Automated Clearing House (NACH).

Table 6: Total number of digital transactions and its value

Financial Year	Total number of Digital Transactions(in crore)	Total value of Digital transactions(in lakh crore)
2017-18	2,071	1,962
2018-19	3,134	2,482
2019-20	4,572	2,953
2020-21	5,554	3,000
2021-22	8,840	3,021
2022-23(31st December)	9,192	2,050

Source: Ministry of Electronics and IT, 08th Feb 2023

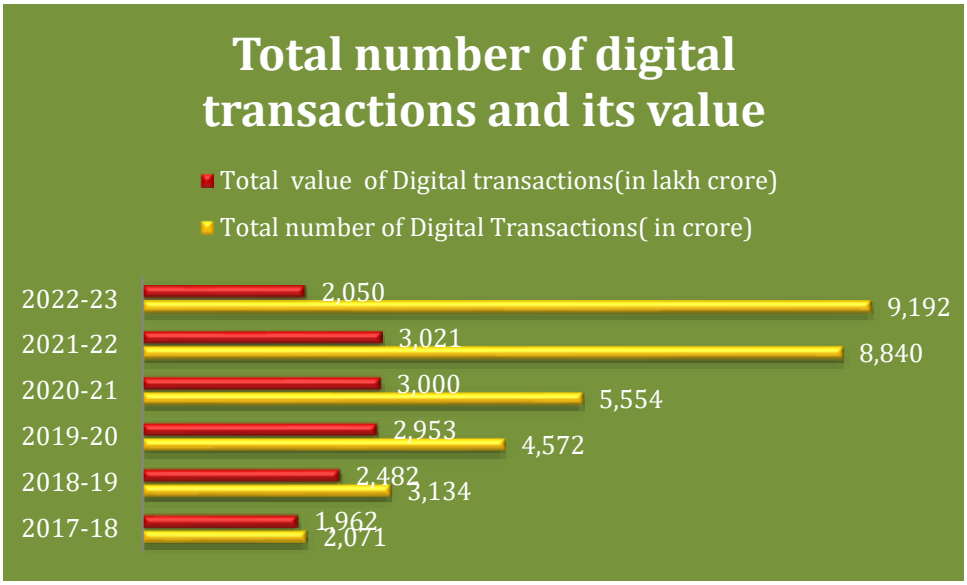

Fig. 1: Total number of digital transactions and their value

5.2 Central Bank Digital Currency and its Impact on Financial Inclusion and Sustainability:

RBI launched the Central Bank Digital Currency (CBDC) or Digital Rupee in November 2022 as the pilot, CBDC issued by RBI has two categories General Purpose or retail (CBDC-R) and Wholesale (CBDC-W) it is in the form of token-based CBDC and Account-based. Token-based CBDC- It would be a bearer instrument, similar to banknotes, with the assumption that whoever holds the tokens at any given time owns them. CBDC-R is recommended since it is more similar to physical currency. Account-based CBDCs would necessitate the keeping of records of all CBDC holders' balances and transactions, as well as the indication of ownership of the monetary balances. This approach should be evaluated for CBDC-W. The Central Bank Digital Currency is the form of flat currency as a sovereign currency and is listed liability side of the central bank's balance sheet. The Reserve Bank of India emphasized the potential reasons for issuing CBDC are to encourage potential savings from reducing cash in circulation, enhance the digital economy and financial inclusion (Juhro, S. M. (2023) [15], CBDC has a huge advantage concerning cryptocurrencies like Bitcoin, Ethereum, Tether, CBDC or e- Rupee is regulated by RBI. CBDC-R is for the general public, it is based on distributed ledger technology (DLT), and its features include secrecy and traceability. It reduces the cash printing and handling costs. CBDC Wholesale (CBDC-W) is meant for financial institutions for settlement and banks to invest in government securities, called money market. CBDCs are issued and managed using two models: direct (single-tier) and indirect (two-tier). A Direct model is one in which the central bank manages all parts of the CBDC system, including issuance, account holding, and transaction verification. In an indirect

approach, the central bank and other intermediaries (banks and other service providers) each have their role.

Currency in circulation (CIC) refers to banknotes and coins printed and minted by the RBI and used in the economy. The cash circulation approach and cash dependence have a greater impact on principal notes with special security features, management costs, and fraud to move away from cash-based payment to cashless payment to enhance financial inclusion (Baskaran, S. A. (2017) [16]. It also brings more transparency to the economy and leads to greater financial literacy. Sustainability involves maintaining Ecological, Economic and social systems through CBDC-based financial services that provide access to banking and Credit for individuals, MSMEs, corporate and unbanked populations in India through smartphones secured and regulated by RBI 4 E's RBI for inclusive through digital technology are E- Payment for everyone, Everywhere, Every time, now Kisan credit cards and digital Dairy loan disbarment with digital technology. Digital technology innovation reshapes the policy, and environment and empowers society in financial decisions and it prioritizes the United Nations Sustainable Development Goals (UNSDG).

CBDC of India has been built to achieve the Sustainable Development Goals (SDG), out of 17 UNSDGs, 8 SDGs -1, 5, 8, 9, 10,12,13,16 remain relevant in the Context of CBDC **(Rybski, R. (2024) [17]** No Poverty (SDG-1), Quality Education (SDG-3), Gender Equality (SDG-5), Decent Work and Economic Growth (SDG-8), Industry, Innovation and Infrastructure (SDG9), Reduced inequalities (SDG-10), Responsible Consumption and Production (SDG-12) Climate Action (SDG-13) and Partnerships for the Goals (SDG17).

Table 7: Impact of CBDC on Sustainable Development Goals

SDGs	Impact
SDG-1.No Poverty	CBDC end poverty in all forms everywhere through CBDC DBT of government subsidies and welfare schemes to the population below the poverty line by eliminating pilferage of funds and timely delivery of benefits through digital rupees and more financial inclusion.
SDG-3. Quality Education	The technology-driven Indian E-rupee will create more e-learning among society including the labour force and create more awareness through capacity-building processes with collaboration between NGOs, Banks and it bring more inclusiveness among society and enhance the digital economy.
SDG-8. Decent Work and Economic Growth	Through the CBDC quick disbursement of loans to the MSMEs helps more sustainable scale up the business and the digital revolution in wholesale (CBDC-W) for Financial Institutions and Retail (CBDC-R) to bring less cost, more financial inclusion and creates a Cashless economy.
SDG-9. Industry, Innovation and Infrastructure	CBDC is a new financial innovation only two countries have launched the digital currency and almost all the emerging countries have introduced CBDC. Digital Currency can use the networks to know-your-customer (KYC), Anti-Money Laundering(AML), Counter terrorist financing(CFT) in the account-based and token-based in Retail as well as wholesale currency to the financial market with Blockchain technology for future innovation and transformation in financial products like Decentralized Finance(DeFi).CBDC can link with UPI. It has the potential to promote innovation in Fintech growth and cross-border payments.
SDG-12. Responsible Consumption and Production	Indian Digital Rupee/CBDC will reduce the cost associated with the cash management system and costs will be borne by stakeholders, with the introduction of CBDC operation costs will be minimized and it will lead to a reduction of ESG costs and enhance more savings among the society thereby ensure the sustainable consumption. The central bank can track the consumption pattern through the centralized Technology of CBDC. As per the study conducted by other countries on the Consumption of

	energy for CBDC transactions, it consumes less energy compared with private digital currency like bitcoin.
SDG-17. Partnership for the Goals	RBI is working in partnership with NPCI, Private and public Banks and with the Bank for International Settlement (BIS) cross-border transactions to bring more innovation to the payment system and for global reach.

Source: Author

Indian Banking Sector is one of the largest networks of banks in the world and recently the government has established Digital Banking Units (DUBs) to increase the banking experience and financial inclusion with minimum infrastructure setup by Scheduled commercial banks it will push the CBDC to reach across the nation.

Table 8: Banking Ecosystem

Types of Bank in India	No of Banks
Public Sector Bank	18
Private Sector Bank	22
Foreign Bank	46
Regional Rural Bank	56
Urban Cooperative Bank	1542
Rural Cooperative Bank	93384
Digital Payment Bank Units	84
Payment Banks	06
Small Finance Bank(SFBs)	12

Source: Inc42 and Author own source

RBI has identified banks for phase-wise participation in the CBDC retail pilot project for effective implementation and to enhance accessibility and financial inclusion by bringing a significant portion of the population into the formal banking system through digitalization by reducing the cost for consumers and industry. The participating Banks are State Bank of India, ICICI Bank, Yes Bank, IDFC First Bank, Bank of Baroda, Union Bank of India, HDFC Bank, Kotak Mahindra Bank, Punjab National Bank, Canara Bank, Federal Bank, Axis Bank and IndusInd Bank to expand to more locations and for the faster acceptance of the digital rupee. RBI issues electronic tokens similar to paper currency, the intermediaries known as Token Service Providers (TSPs) and banks obtain these tokens from RBI TSP Merchants and these tokens are available to the customers in their digital wallets in different denominations.

The RBI prints and manages currency, and the Government of India regulates denominations. The RBI incurs large costs for printing currency notes, and Bharatiya Reserve Bank Note Mudran Limited (BRBNMPL) and Security Printing and Minting Corporation of India Limited (SPMCIL) is a printing and Minting company. CBDC can reduce the cost of traditional paper money issuance and circulation, save on manpower and materials, promote financial inclusion, provide stable and efficient transactions, and improve cross-border transactions (Lee C. et al. 2021) [18].

Table 9: Expenditure incurred on printing of Currency

Financial Year	Cost of Printing (Rupee thousand Crores)
2018-19	4.81
2019-20	4.38
2020-21	4.01
2021-22	4.98
2022-23(April- March)	4.68

Source:https://factly.in/data-share-of-high-value-currency-notes-in-circulation-increases-slightly-by-2022-23-end/

Graph 2: Expenditure incurred on printing of Currency

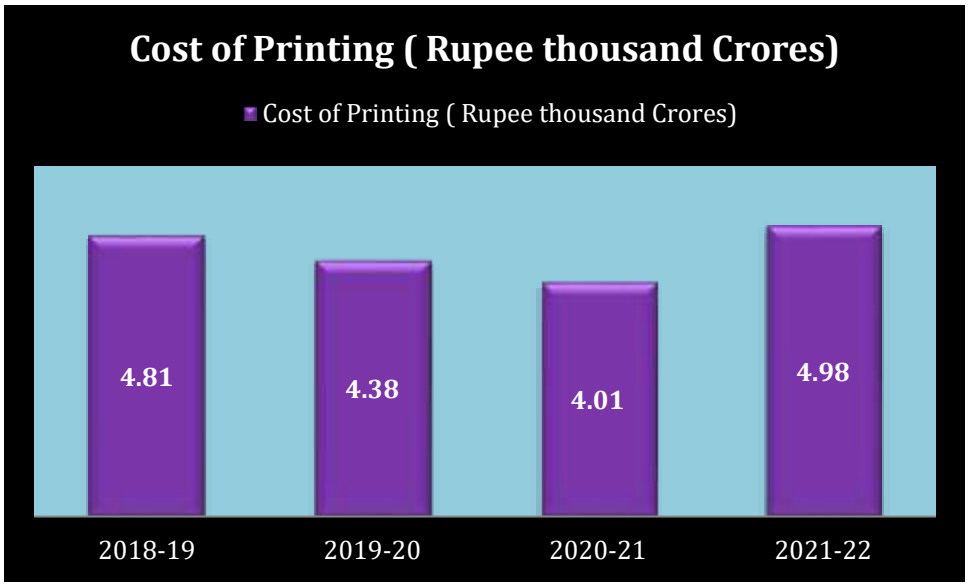

Fig. 2: Expenditure incurred on printing of Currency

According to the International Monetary Fund (IMF), India's GDP is expected to overtake Germany's and Japan's by 2027, becoming the world's third-largest behind the United States and China, and it has already surpassed the United Kingdom. The RBI employs macroeconomic research to factor in the issuance of required currency notes, interest rates, growth in non-cash modes of payment, GDP growth projections, inflation, and the disposal of denomination-specific dirty notes, the method most commonly used to express a country's cash use is to compute the currency in circulation (CIC) to nominal GDP ratio (Khiaonarong, T et al. 2019) [19]. The currency to GDP ratio of 12.7% in the year 2022-23 as compared with 2021-22 was13.4% there is a fall in the GDP ratio. The currency circulation includes Banknotes and coins. The Growth rate in 2021-22 fell to 9.87% compared to 16.7 % in the earlier year. During 2022-23, the growth rate further slowed down to 7.8 % in terms of the value of total currency notes in circulation. Table 10 presents the Value and Volume of Currency Notes in Circulation and Currency to GDP ratio year-wise.

Table 10: Expenditure incurred on printing of Currency

Financial Year	Value (Lakh Crores)	Volume(Thousand Crores)	The growth rate in %	%GDP
2018-19	21.11	10.88	16.8	11.3
2019-20	24.21	11.6	14.5	12.2
2020-21	28.27	12.44	16.6	14.4
2021-22	31.06	13.05	9.8	13.4
2022-23(End of March)	33.48	13.62	7.8	12.7

Source: https://factly.in/data-share-of-high-value-currency-notes-in-circulation-increases-slightly-by-2022-23-end/

As per the findings of the Atlantic Council Geoeconomics Central Bank Digital Currency Tracker analysis, 19 of the G20 Countries are in the advanced stage of CBDC development 11 countries have fully launched digital currency as of December 2023 and countries are using Wholesale CBDC or Retail CBDC and both and some countries till in research. RBI has identified 13 commercial banks for retail and wholesale interbank transactions for the pilot study. The country of world UK, Thailand, Russia,

Canada, France, Germany, China, and Japan have recognized the importance of blockchain technology for CBDC (Bhat, V et al. 2021) [20].

Table 11: List of Countries that launched and conducted Pilot projects on CBDC

Countries	Name of CDBC	Type of CBDC	Infrastructure/Technology
India	e-Rupee/Digital Rupee	Wholesale & Retail	Both Conventional and DLT
Bahamas-1st country	Sand Dollar Back	Retail	Both Conventional and DLT
Nigeria	e-Naira	Retail	DLT
Jamaica	Jam-DEX/e-Cedi	Retail	Conventional
Germany	Digital Euro	Wholesale & Retail	Both Conventional and DLT
United Arab Emirates		Retail& Wholesale	DLT
Japan	Digital Yen	Wholesale & Retail	Intermediated
Sweden	e-Krona	Retail	DLT
HongKong	e-HKD	Wholesale & Retail	Intermediated
Australia	--	Wholesale& Retail	Ethereum
Pakistan	--	Research- Retail	-
SriLanka	--	Research	-
Nepal		Research	-
Bangladesh		Research	-
United States	Development	Wholesale & Retail	Intermediated
United Kingdom	Development	Wholesale & Retail	Intermediated
Bhutan	Development	Wholesale& Retail	Ripple
Myanmar	Research	Research	--
South Africa	Pilot	Wholesale	-

Source: Author

Table 12: Legal Framework for Issuing Digital Rupee: To reduce dependency on Cash and to create a more efficient, trusted, secured, regulated legal tender-based payment system various relevant Acts and provisions are essential for Digital Currency.

Act	Impact on CBDC
The Finance Act, 2022 & The Reserve Bank of India Act,1934& The Coinage Act, 2011	To Amend the definition of banknote, section 22 & New section 22 an RBI Act relevant for physical bank notes applicable to the digital bank note.
The Information Technology Act, 2000 and the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information Rules, 2011.	Sharing the Data outside India for a cross broader transaction
The Foreign Exchange Management Act,1999 (FEMA)	W-CBDC for cross-border payment between different countries
The Prevention of Money Laundering Act, 2002	For Know–Know Your Customer KYC) for tracing transactions and traceable large-value transactions
Banking Regulation Act,1949	Participation of financial institutions and their infrastructure
Payment Bank 2014, Account Aggregator 2016, Pre-Paid instruments 2017, Peer-to-Peer Lending 2017, Invoice discounting 2018.	

Technological advances have increased interest in the Central bank to experiment with the CBDC along with Commercial banks, three CBDC models are being implemented Wholesale CBDC, retail CBDC and cross–currency CBDC Across the globe. India launched a pilot project of CBDC on, December 2022 with participating banks in the retail segment. RBI has provided a Negotiated Dealing System-Order Matching (NDS-OM) platform to Banks to trade G-Security by using CBDC: account-based CBDC-W and Token-based R-CBDC forms used by RBI for the Pilot Project.

Table 13: Impact of the CBDC Pilot Project of CBDC-W & CBDC-R

CBDC-W & CBDC-R	Rupees in Cores & No.
Total Digital Rupee/CBDC in Circulation(Feb-2022-23	2.73 Crore
No Retail CBDC Users	50000 users and 5000 Merchants
Total Transactions	770,000
Wholesale total Numbers	1329
CBDC issued to participating Banks	1.71 Crore &1.02 crore
Value of Wholesale CBDC (31st March)	10.39 Crore
Value of Retail CBDC	5.7 Crore

Source: Inc42

6. CONCEPTUAL FRAMEWORK ON 5 C'S APPROACH OF CBDC :

Centralized Blockchain Digital Currency (CBDC) is a digital currency issued and regulated by a central authority, such as a government or central bank. It operates on a blockchain network, allowing for secure and transparent transactions while maintaining central control over monetary policy. CBDC aims to provide the benefits of blockchain technology, such as immutability and transparency, while retaining centralized oversight and regulation.

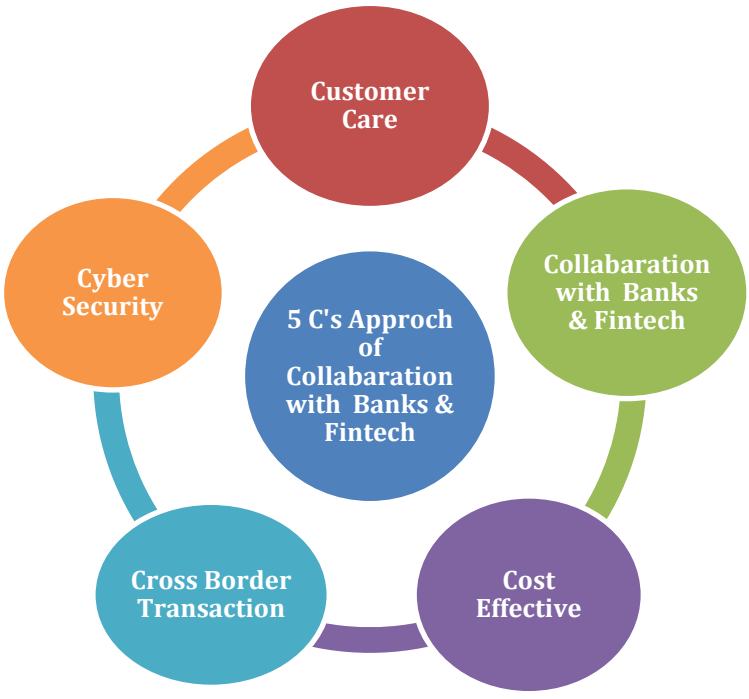

Fig. 3: 5 C'S APPROACH OF CBDC

Source: Author

6.1 Customer care: Customer care for CBDC involves addressing inquiries, concerns, and issues related to the usage of the centralized blockchain digital currency. It encompasses guiding setting up accounts, and transactions, and understanding the features and benefits of CBDC. Customer care agents assist users in navigating the CBDC platform, resolving technical glitches, and ensuring smooth transactions.

6.2 Collaboration with Banks & Fintech: Collaboration between banks and fintech firms under CBDC involves integrating technical systems, enhancing user experiences, ensuring security and compliance, promoting financial inclusion, and driving innovation in digital currency solutions.

6.3 Cost Effective: By leveraging blockchain technology, CBDC can streamline transaction processes, reducing the need for intermediaries and associated fees. The centralized nature of CBDC allows for easier maintenance and management, minimizing operational costs compared to traditional currency systems. CBDC's digital format eliminates the need for physical printing and distribution of currency, further reducing overhead expenses. Automation of processes such as auditing and reconciliation through smart contracts can lower administrative costs associated with CBDC management.

6.4 Cross-border transactions: CBDC facilitates cross-border transactions by providing a digital medium of exchange that can be transferred instantly across borders. Through the use of blockchain technology, CBDC ensures transparency, security, and immutability of cross-border transactions, reducing the risk of fraud or manipulation. The centralized nature of CBDC allows for seamless integration with existing financial systems, simplifying cross-border transactions and reducing processing times. CBDC eliminates the need for intermediaries such as correspondent banks, reducing transaction costs and delays associated with traditional cross-border payments.

6.5 Cyber security: CBDC employs advanced encryption techniques and distributed ledger technology to ensure the integrity and confidentiality of transactions, enhancing cyber security measures. Robust authentication protocols and multi-factor authentication mechanisms are implemented to prevent unauthorized access to CBDC wallets and accounts. Continuous monitoring and real-time threat detection systems are utilized to identify and mitigate cybersecurity risks, safeguarding CBDC transactions and user information. Regular security audits and penetration testing are conducted to assess vulnerabilities and strengthen the overall cybersecurity posture of the CBDC system.

7. SUGGESTIONS :

(1)The interoperability of the Unified Payment Interface (UPI) and Central Bank Digital Currency (CBDC) will enhance CBDC transactions.
(2) Commercial and private banks need to issue circulars, mandating their employees to register and use the CBDC digital rupee app.
(3) The Reserve Bank of India (RBI) needs to ensure that commercial and private banks create more awareness about CBDC wallets and QR code usage to increase CBDC usage.
(4) The Direct Benefit Transfer (DBT) government scheme should only use CBDC to promote financial inclusion.
(5) The Bharat Net connection should be improved in rural areas to expand the reach of CBDC.
(6) Retail investors should be allowed to use CBDC currency to invest in stock market transactions.
(7) Interest in the CBDC digital rupee wallet should be encouraged to expand its reach and promote savings.

8. CONCLUSION :

Central Bank Digital Currencies (CBDC) can potentially increase financial inclusion for rural and unbanked people. This is owing to the widespread usage of cell phones and the expansion of the Bharat Net project, which provides internet connectivity in remote areas. Furthermore, direct benefit transfers (DBTs) from government initiatives to beneficiaries can help speed digital inclusion. The implementation of the RBI's CBDC has a substantial impact on reaching the SDGs. It increases prospects for FinTech entrepreneurs while lowering operational expenses as compared to traditional money systems. It also has a greater impact on future cashless societies and digital economies. The Reserve Bank of India (RBI) and the Indian government have been promoting using Central Bank Digital Currency (CBDC) to improve cross-border payment transactions and reduce the cost of managing cash. They have also highlighted its positive impact on GDP, the environment and payment efficiency. The CBDC would be controlled by a centralized blockchain system, authorized by the RBI and the government, and would be recognized as legal tender money. The initial research on Central Bank Digital Currency for both Retail (CBDC-R) and Wholesale (CBDC-W) has resulted in a

significant reduction in financial transaction settlement risk when compared to other countries. The introduction of RBI CBDC, which is the digitization of sovereign currency, will lead to digital transformation, innovation, and inclusivity and also contribute to achieving the United Nations' Sustainability Development Goals (SDGs) through environmental, social and governance (ESG) objectives.

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