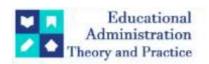
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Research Article



Inclusive Financial System in the Indian Context

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ABSTRACT

An Inclusive financial system in India has emerged as a contemporary and critical developmental priority aimed at ensuring access to useful and affordable financial services for all individuals. It is particularly targeted at the unserved and the underserved regions of India, so that they also get the opportunity to become part of India's inclusive development and growth. This paper aims to explore the current status, progress, persistent challenges and future endeavours of financial inclusion in India, driven by government initiatives, regulatory frameworks, and technological innovations. Key programs such as the Pradhan Mantri Jan Dhan Yojana (PMJDY), Direct Benefit Transfers (DBT), and the rise of digital payment infrastructure have significantly expanded the reach of banking and financial services. Despite notable achievements, gaps remain in financial literacy, lastmile delivery, and digital access. Financial Inclusion stands as one of the many strong pillars of inclusive development and hence is a very crucial means to the achievement of the end target of all-encompassing inclusion of Indians from different socio-economic strata and regions. This study analyzes the role of stakeholders, including public and private sectors, in deepening financial inclusion and emphasizes the need for inclusive policies, financial education, and robust digital ecosystems to bridge the remaining divide. The findings underscore financial inclusion not just as an economic enabler, but as a catalyst for social equity and sustainable growth in India.

KEYWORDS: Inclusion, Banking, Literacy, Development, Empowerment, Upliftment

Introduction

Characterised by its dynamic and varied population, India is treading on the path of one of the fastest-growing economies and desiring to reap the demographic dividend with inclusive development across different sections of society. All this also remains a significant objective of the governments that must come to power. However, reaching these targets requires working on several fronts, one being financial inclusion, with a promising multiplier and accelerator impact on multiple areas of societal development. As per the World Bank report, India is second in the total number of financially excluded people, with China in first place. The report also mentions that around 36% of the population has an operational bank account. This now channelizes our attention towards the paramount invisibility of this vast population deprived of financial services and sustaining as an unbanked population. The research proposal aims to analyse the issue from all dimensions and reach a more informed conclusion. I tend to present findings on this issue through understanding and analysis of the works of different researchers and academicians in this field. The following research note has been organised in the format that starts with a brief explanation of the issue of financial inclusion based on a study of multiple research papers on this contemporary topic. It includes the utility of financial inclusion in India's ongoing development path and a brief overview of the ground-level penetration achieved until now. Financial inclusion in India has emerged as a cornerstone of the country's development agenda, aiming to provide affordable and accessible financial services to all, particularly marginalized and low-income groups. The concept has gained momentum since the early 2000s, with the Reserve Bank of India (RBI) and successive governments launching a series of initiatives to bridge the gap between the financially included and excluded populations (Panwar et al., 2022; Barot, 2017).

Significance of financial Inclusion for an economy

According to World Bank definition, financial inclusion refers to availability, accessibility and affordability of financial items and services to all sections of society ranging to households, businessman, farmer, trader, rural and urban persons etc means that meet their needs – transactions, payments, savings, credit and insurance – delivered in a responsible, and sustainable way.

The ideal aim of financial inclusion remains to provide access to financial services to all sections of society, wherein even the last person in the row also gets to use what he/she desire in finance. This issue's increased importance and centrality in policy measures are due to its wide-ranging utility and multiple benefits to large-scale sections of society. The following paragraph will present these benefits.

The foremost benefit to the whole economy at the macro level is the expansion of its resources through increased credit availability in the banking sector. Increased resources have many positive impacts, such as infusing liquidity in the market and a spurt in fund availability, which can be channelized to business people, entrepreneurs, industrialists, and other investors. Increased investment raises production processes and total output of the economy. Increased production also generates employment and thus decreases the overall unemployment level amongst the workforce. A banking sector with more resources makes the financial system healthier and instils confidence in the business class and foreign investors. Moreover, per development models like Harrod-Domar and Solow, savings are central in determining economic investment and overall growth and output. At the micro level for households, it imparts a habit of saving and thus overall savings in the economy. Households generally use financial services for three primary purposes. These are first, contingency planning which includes retirement savings, buffer savings, and insurance benefits, second, for credit which means use of financial services for consumption loans, housing loan, self-employed business and other emergencies and lastly for wealth and asset creation in form of savings and investments based on individual's understanding of financial products and risk analysis.

Moreover, its significance in reducing inequality is again paramount. It connects people from the vulnerable section to the formal banking system, from where they could access various services and benefits under social security schemes. Direct benefit transfer to bank accounts and reduction in exclusion and inclusion errors are further assured through financial inclusion. Provisioning credit to farmers is one of the crucial elements of financial inclusion. The NSSO 59th round survey shows that around 50% of farmers are indebted. In such a backdrop, providing financial services to farmers promises to uplift farmers from distress and enhance productivity in the banking agriculture sector. The Self Help Groups have increased manifold post financial inclusion initiatives like the SHG bank Linkage program of NABARD. SHGs hold at stake enhanced livelihood opportunities for rural households, financial security, and overall empowerment of the rural female workforce, which has been able to channel their potential through the secured mechanism of the SHGs system.

Apart from this, banks also feel confident and tend to actively provision funds under schemes like Priority sector Lending to the unreached section of society that has low accessibility to credit due to their lack of collateral and low creditworthiness. Channeling funds to these strata of society helps them access alternative employment opportunities and thus raises their per capita income, which then gets into the banking system through savings and thus further helps create more credit through the multiplier effect, leading to an all-around win-win model.

Thus, financial inclusion positively impacts the overall health of the economy, the banking sector, and industrial output. It trickles down its benefits to small and marginal farmers, rural masses, females yearning for employment and income generation activities, and the widely spread unorganised sector. Financial inclusion holds centrality in the concept of inclusive development, which remains the ideal target of most developing and underdeveloped economies.

Thus, the significant contribution of financial inclusion remains in developing a culture of savings amongst households, specifically the poor sections, which remained out of the network of the formal credit system. The study on financial inclusion highlights not only the level of development in a particular society and how inclusive such development is, but it also focuses on the financial indicators of its citizens.

History of Financial Inclusion

Historically, financial inclusion in India was limited, especially in rural areas where most of the population resides and access to formal banking was scarce (Bhattacharya, 2020). Post-independence, the expansion of the formal banking sector, microfinance institutions, cooperatives, and non-banking financial companies sought to extend services to underserved communities (Barot, 2017). In India, financial inclusion dates back to pre-independence times. However, it was relatively rare due to the British Government's lack of interest in this, and big banks run by Indians mainly carried it out. Post-Independence, the process of provisioning financial services to the larger masses was enthusiastically taken forward by the RBI and later on supported by government policies aimed at financial inclusion, and ever since then, India has remained one of the front-runners in expanding and disbursing financial services to people with low incomes. The formal banking sector expanded, and other institutions like Microfinance Institutions, Cooperatives, non-banking financial institutions, etc., were set up to provide financial services and products to the masses. The major spurt in this direction came with bank nationalisation in 1969, followed by a second round of nationalisation in 1980. The initiatives taken towards bringing the masses into the network of the financial sector are the expansion of regional branches, followed by the service area approach, the lead bank scheme, the setting up of regional rural banks, urban cooperative banks, small finance banks, and so on. According to Reserve Bank of India statistics,

the development of the banking sector during the 1970s and 1980s led to a fourfold expansion of bank branches from around 9000 in 1970 to around 35000 in the 1980s. The formal use of the nomenclature 'Financial Inclusion' and its increased centrality in policy measures came after the Khan Committee was set up by the Reserve Bank of India in 2004, to look into the question of financial measures and suggest measures. Since then, the RBI and the central government are treading toward enhanced financial inclusion.

Steps taken by the Government and the Central Bank in the direction of financial inclusion

The Lead Bank scheme was set following the findings and recommendations of the Gadget Committee in 1969. This scheme's prime objectives were to reduce unemployment through providing credit to the agricultural sector, small-scale industries, and rural men. This would eventually lead to alternative employment opportunities and raise the standard of living. The lead bank scheme was implemented based on the 'area approach', wherein targeted and focused banking was executed.

Regional rural banks set up under the Regional Rural Bank Act 1976 began operation with just five branches and now have reached pockets of rural and semi-urban areas. The primary objective of regional rural banks through their niche banking operations was provisioning banking services and facilities to rural areas and other unbanked sections, disbursement of wages under the MGNREGA scheme, facilitating pension schemes, and providing other banking facilities like small loans to farmers and cooperatives, locker facilities, credit and debit cards.

Priority sector lending is a mandatory norm being carried by scheduled banks under the overall supervision of the Reserve Bank of India. PSL works on the principle of channelizing funding in a prioritised manner to specific sections of society where access to formal credit has not been penetrated according to demand generated from these sections. Under this, all scheduled commercial and foreign banks are supposed to provide 40% of total adjusted net banking credit to sectors such as agriculture, micro, small, and medium enterprises, housing, education, renewable energy, and social infrastructure. If banks fail to fulfil the target, they should purchase priority sector lending certificates. This mechanism ensures that a specific percentage of credit is being provided to weaker sections, ensuring credit flow to them, giving a sense of security, bringing them out of the clutches of informal credit with exorbitantly high rates, and motivating them to take on incomegenerating ventures.

The Self-Help Group Linkage program, under the overall supervision and monitoring of the National Bank for Agriculture and Rural Development, has played a significant role in linking self-help groups to the formal banking system, supporting their entrepreneurial activities and income generation ventures. The Financial Stability and Development Council is being set up following recommendations of the Raghuram Rajan Committee in 2008 to coordinate financial market regulators and focus on financial inclusion and financial literacy.

The easing of KYC, i.e., Know Your Customer norms, through measures like shortened documentation for accounts not exceeding Rs50,000, use of two identity proofs despite four initially, and local language use in the form for account opening. Moreover, employing business correspondents, customer service points, technology vendors, and rural intermediaries has further expedited the process for people. Further use of electronic benefit transfers and direct benefit provisioning has further facilitated social scheme benefits to poor and motivated beneficiaries to remain more linked to financial services and the banking sector. Introduction of the Kisan Credit card enables the farmers to get formal credit from banks without remaining dependent on money lenders or landlords, which usually puts them in a vicious cycle of debt. It helps meet financial requirements in other agriculturally related allied activities and further investment opportunities in areas like technology enhancement, livestock, etc. Marketing loans help farmers by saving them from intermediaries and distress sales in the market. Post-harvest expenses and insurance schemes are also covered under the Kisan Credit Card scheme.

Pradhan Mantri Jan Dhan Yojana, introduced in 2014, was a significant initiative in financial inclusion. Opening a bank account with zero balance and linking it to various schemes to operationalize them remained the scheme's main features. Such large-scale and deep penetration of banking services at an affordable cost gave the required impetus to financial inclusion amongst the Indian masses. The active role of bank correspondents or bank mitras has helped an enormous population get linked to the formal banking sector. National Payment Commission of India further supported the initiative by efficiently issuing debit cards on a wide scale

It assures account holders access to various banking services like savings accounts, debit cards, and need-based credit cards, remittances, and insurance and pension benefits, thereby furthering the objective of social security via financial inclusion. Other important features of Jan Dhan Yojana include a Rupay connected debit card, a Rs 5000 overdraft facility, insurance coverage, and an inbuilt accident cover provision.

Major policy interventions, such as the Pradhan Mantri Jan Dhan Yojana (PMJDY), have significantly increased the number of bank accounts, especially after 2014, and promoted digital finance, particularly in the post-demonetization era(Barik & Sharma, 2019). Other government schemes, including rural employment programs and direct benefit transfers, have further propelled financial inclusion(Kaur et al., 2017).

Apart from this, some of the new initiatives in this direction remain schemes like e-Gram, Farmer's Club Program, General Credit Card, Customer Service Centres, Credit counselling centres, financial literacy programs undertaken by Doordarshan, and so on, and a greater drive towards digitalisation.

The initiatives undertaken by both the central bank and the government, which are mentioned above, bring us awareness about the mechanism the government is following for financial inclusion penetration into the masses. However, we need to see how far masses have absorbed it by looking at the ground situation to complete our understanding of the whole issue. Thus, the following portion will look into the progress made by these initiatives and the level of financial inclusion achieved in India.

Cruciality of Financial Inclusion for Overall Inclusive Development

Financial inclusion is widely recognized as a critical driver for inclusive development, aiming to ensure that all individuals and businesses—especially those traditionally excluded—have access to affordable and quality financial services. By expanding access to banking, credit, insurance, and digital financial tools, financial inclusion helps reduce poverty and income inequality, particularly among marginalized groups such as women and rural populations(Omar & Inaba, 2020; Cabeza-García et al., 2019; Sharma & Changkakati, 2022; Cicchiello et al., 2021). Evidence from global and regional studies demonstrates that increased financial inclusion is associated with higher economic growth, improved human capital, and progress toward the United Nations Sustainable Development Goals, including better education, gender equality, and reduced infant mortality(Sharma & Changkakati, 2022; Thathsarani et al., 2021; Mostafa et al., 2023).

Key factors influencing financial inclusion include income, education, financial literacy, and institutional quality(Hasan et al., 2021; Zeqiraj et al., 2022; Wang & Guan, 2017). Financial literacy, in particular, empowers individuals to utilize financial services effectively, breaking down barriers to participation and fostering prosperity(Hasan et al., 2021). In developing countries, targeted policies that enhance literacy, promote gender equality, and address pay disparities are essential for empowering vulnerable groups and driving inclusive development(Cicchiello et al., 2021; Cabeza-García et al., 2019).

However, the impact of financial inclusion is not universally positive or automatic. Some research highlights that the benefits depend on the broader socio-economic context, the quality of institutions, and the design of financial products(Mader, 2018; Li et al., 2021). In some instances, without complementary policies and community support, financial inclusion alone may not achieve sustainable development and could even exacerbate vulnerabilities(Li et al., 2021; Mader, 2018).

Hence, financial inclusion is a powerful tool for inclusive development. However, its effectiveness relies on supportive policies, financial literacy, and attention to local contexts to ensure that all segments of society benefit equitably.

Progress and Achievements

India has witnessed rapid progress in financial inclusion, with notable increases in bank account ownership and digital transactions (Barik & Sharma, 2019; Thermadam, 2020). The expansion of ATMs, bank branches, and mobile banking has been crucial in reaching remote and rural populations (Jammu, 2025; Kaur et al., 2017). Financial inclusion has contributed to poverty reduction, women's empowerment, and economic growth by enabling access to credit, insurance, and savings products (Jammu, 2025; Panwar et al., 2022; Iqbal & Sami, 2017). Empirical studies confirm financial inclusion's positive and significant impact on India's GDP and economic development, with improvements in both demand- and supply-side financial services driving long-term growth (Iqbal & Sami, 2017; Sethi & Sethy, 2019).

Also, according to the International Monetary Fund's Financial Access Survey, India has approximately 30.5 bank branches per 100km and 25.6 ATMs per 100km, one of the lowest among countries in the world.

According to Reserve Bank of India Report on Trends and progress of Banking in India, 2017, the number of locations covered by business correspondents have increased from 486 in 2010 to 102867 in 2017, the banking locations in rural areas have increased from 33387 to 50608 over the same period and total number of Kisan Credit card have increased from 24 million to 45 million from 2010 to 2017. According to the World Bank Report, the total financial inclusion percentage remains 36% of the adult population.

Challenges and Persistent Anomalies

All the data discussed above brings us mixed results. Even though financial inclusion initiatives have progressed over time, the penetration is not at the optimum level or as policymakers desire. Hence, despite the advances, significant challenges remain. Many accounts remain inactive, and usage of digital payments is still low among women, rural residents, the elderly, and less-educated groups(Barik & Sharma, 2019; Thermadam, 2020). Barriers such as lack of financial literacy, insufficient digital infrastructure, and socio-economic factors like income and education hinder full inclusion(Thermadam, 2020; Bhanot et al., 2012). Additionally, the benefits of financial inclusion are not evenly distributed, and further efforts are needed to ensure that the most vulnerable populations are reached(Barik & Sharma, 2019; Thermadam, 2020; Bhanot et al., 2012).

The frictions persist because of the low financial literacy amongst the masses, which makes them feel unconfident and insecure in using financial services. Many people fear losing money just because they lack knowledge of financial products and services. The apprehension of banks about asymmetric information and the possibility of moral hazard due to lack of collateral and the creditworthiness of the rural masses inhibits them in many cases from extending credit. Stemming from this, the government has kept rural banking at the helm of public banks and restricted competition, and consequently, larger penetration through initiatives like the service area approach. The problem at times with rural banks working under public sector initiative is a

low incentive structure and paucity of credit, which could be extended to the masses. Another issue is the weak regulatory mechanism of banks, wherein they lag behind in checking beneficiaries' compliance. The cost of engaging and dealing with the poor population for banks is relatively high, which reduces banks' overall profitability and thus dissuades them from increased lending. Since banks are the mechanism of achieving financial inclusion of the masses, their backstop from lending impacts the initiative hugely. Apart from this, the unintended consequence of credit rationing, which results from a differential interest rate structure for lower strata, further affects the efficiency of the banking system. The recent debates on the MUDRA scheme, based on Raghuram Rajan's findings on how MUDRA loans can become future nonperforming assets for banks, have further raised apprehensions about micro lending and its consequences.

The network services in many places are pretty weak, which delays the overall banking process for people, thus raising their costs compared to the benefits. The lack of formal identification documents, which banks require from beneficiaries, further impedes the process of financial inclusion and accessibility of financial services to the beneficiaries. Lack of guidelines for consumer protection, which adds insecurity in the masses, is another reason behind low penetration. Another factor in this is the low operability of bank accounts, especially those opened under Jan Dhan Yojana, which adds to a considerable number of frill accounts that, on paper, show a quantity of bank accounts with low qualitative impact.

Recommendations for further progress

The foremost effort should be in the direction of more citizen participation by raising their confidence and reducing insecurity regarding financial services, as multiple efforts taken in this direction will be nullified if the masses do not get involved. For this to happen, expedited financial literacy programmes should be initiated, and more banks, mitras, and business correspondents should be recruited, while easing KYC norms. Other areas where steps could be taken regarding easing financial services are the introduction of doorstep banking (e.g., being a Post Office bank), flexible financial items and services that satisfy the needs of poor people, like a short-term installment option available to loan takers. Even though niche banking ensures greater efficiency, composite banking for regional areas should be encouraged as the masses seek to have loan facilities and other services like social scheme benefits, insurance, etc. Apart from this, internet connectivity should be ensured for greater penetration of mobile banking, specifically at community service centres and elsewhere. At the macro level, revisiting the Priority Sector lending scheme to ensure more compliance and increased competition in banking holds promise for a greater number of services for people. Another important area to ponder is the reduction in frill accounts and more operationalisation of accounts opened under various schemes, specifically the zero balance account.

Conclusion

Financial inclusion in India has made remarkable strides, driven by policy initiatives and technological advancements. However, to achieve universal and meaningful inclusion, ongoing efforts must address persistent barriers, promote financial literacy, and ensure equitable access to financial services across all segments of society.

Therefore, studies on financial inclusion offer further scope to understand areas where anomalies in its complete penetration exist, like negligence and disinterest of people in using financial services, the merits it offers to the economy at the macro level, and the reluctance of banks in further extension of social services to vulnerable and deprived sections. Thus, financial inclusion is one of the most crucial elements of inclusive development targets, and hence policymakers and stakeholders must analyse gaps and anomalies, and data-driven initiatives must be taken in the direction of filling these gaps to achieve complete financial inclusion across all caste, gender, and regional groups.

REFERENCES: -

- 1. Basu, Priya, 2017, 'A Financial System for India's Poor', Economic & Political Weekly, Vol III no.37
- 2. Mohan, Rakesh, 2005, 'India's experience with financial sector development', Macmillan, New Delhi & World Bank
- 3. Dev, Mahendra, 2006, 'Financial Inclusion-Issues & Challenges', Economic & Political Weekly, Vol 41
- 4. Rao, Subha KG, 'Financial Inclusion: An introspection', Economic & Political Weekly Vol 42 no.5
- 5. GoI: Economic Survey, 2018, Department of Economic Affairs, Ministry of Finance
- 6. NSS Report no. 497, Central Statistics Organisation, GoI
- 7. World Bank: Global Findex Report, 2019.
- 8. Cabeza-García, L., Brio, E., & Oscanoa-Victorio, M. (2019). Female financial inclusion and its impacts on inclusive economic development. Women's Studies International Forum. https://doi.org/10.1016/j.wsif.2019.102300
- 9. Mader, P. (2018). Contesting Financial Inclusion. Development and Change, 49, 461-483. https://doi.org/10.1111/DECH.12368

- 10. Sharma, U., & Changkakati, B. (2022). Dimensions of Global Financial Inclusion and Their Impact on the Achievement of the United Nations Development Goals. Borsa Istanbul Review. https://doi.org/10.1016/j.bir.2022.08.010
- 11. Omar, M., & Inaba, K. (2020). Does financial inclusion reduce poverty and income inequality in developing countries? A panel data analysis. Journal of Economic Structures, 9. https://doi.org/10.1186/s40008-020-00214-4
- 12. Cicchiello, A., Kazemikhasragh, A., Monferrà, S., & Girón, A. (2021). Financial inclusion and development in the least developed countries in Asia and Africa. Journal of Innovation and Entrepreneurship, 10, 1-13. https://doi.org/10.1186/s13731-021-00190-4
- 13. Jammu, C. (2025). Dynamics of Financial Inclusion in India. International Journal of Management and Humanities. https://doi.org/10.35940/ijmh.d1766.11060225
- 14. Bhattacharya, R. (2020). Financial Inclusion in India. Wealth Creation and Poverty Reduction. https://doi.org/10.4018/978-1-4666-9908-3.CH005
- 15. Barik, R., & Sharma, P. (2019). Analyzing the progress and prospects of financial inclusion in India. Journal of Public Affairs. https://doi.org/10.1002/PA.1948
- 16. Thermadam, S. (2020). Financial Inclusion in India. Artha Journal of Social Sciences. https://doi.org/10.12724/ajss.53.3
- 17. Panwar, V., Jha, A., Bhura, P., & Negi, K. (2022). FINANCIAL INCLUSION IN INDIA AN ASSESSMENT. Sachetas. https://doi.org/10.55955/110005
- 18. Barot, P. (2017). Financial Inclusion in India. Imperial journal of interdisciplinary research, 3.
- 19. Kaur, S., Kaur, M., & Madan, P. (2017). FINANCIAL INCLUSION IN INDIA. International Education and Research Journal, 3.
- 20. Iqbal, B., & Sami, S. (2017). Role of banks in financial inclusion in India. Contaduría y Administración, 62, 644-656. https://doi.org/10.1016/J.CYA.2017.01.007
- 21. Bhanot, D., Bapat, V., & Bera, S. (2012). Studying financial inclusion in north-east India. International Journal of Bank Marketing, 30, 465-484. https://doi.org/10.1108/02652321211262221
- 22. Sethi, D., & Sethy, S. (2019). Financial inclusion matters for economic growth in India. International Journal of Social Economics. https://doi.org/10.1108/IJSE-10-2017-0444
- 23. Thathsarani, U., Wei, J., & Samaraweera, G. (2021). Financial Inclusion's Role in Economic Growth and Human Capital in South Asia: An Econometric Approach. Sustainability, 13, 4303. https://doi.org/10.3390/SU13084303
- 24. Hasan, M., Le, T., & Hoque, A. (2021). How does financial literacy impact inclusive finance?. Financial Innovation, 7. https://doi.org/10.1186/s40854-021-00259-9
- 25. Mostafa, S., Ashraf, S., & Marwa, E. (2023). The Impact of Financial Inclusion on Economic Development. International Journal of Economics and Financial Issues. https://doi.org/10.32479/iiefi.14107
- 26. Zeqiraj, V., Sohag, K., & Hammoudeh, S. (2022). Financial Inclusion in Developing Countries: Do Quality Institutions Matter?. Journal of International Financial Markets, Institutions and Money. https://doi.org/10.1016/j.intfin.2022.101677
- 27. Wang, X., & Guan, J. (2017). Financial inclusion: measurement, spatial effects, and influencing factors. Applied Economics, 49, 1751 1762. https://doi.org/10.1080/00036846.2016.1226488
- 28. Li, A., Gao, L., Chen, S., Zhao, J., Ujiyad, S., Huang, J., Han, X., & Bryan, B. (2021). Financial inclusion may limit sustainable development under economic globalization and climate change. Environmental Research Letters, 16. https://doi.org/10.1088/1748-9326/abf465