Financial inclusion for inclusive growth in india

Amartya Sen (2000) convincingly argued that poverty is not merely insufficient income, but rather the absence of wide range of capabilities, including security and ability to participate in economic and political systems. Franklin Roosevelt, the popular president of United States of America in 1932, referred to the American poor as the forgotten man at the bottom of the economic pyramid. Today the term `bottom of the pyramid' refers to the global poor most of whom live in the developing countries. These large numbers of poor are required to be provided with much needed financial assistance in order to sail them out of their conditions of poverty. Joseph. E. Stilglitz opines that, if economic growth is not shared throughout society then development has failed. Accordingly, there is felt a need for policy support in channeling the financial resources towards the economic upliftment of resource poor in any developing economy.

This study is an attempt to comprehend and distinguish the significance of Financial Inclusion in the context of a developing country like India wherein a large population is deprived of the financial services which are very much essential for overall economic growth of a country. Our understandings and analysis on the topic are presented here below in the following sections. In Section-II, the importance of `Finance' for economic growth has been established with adequate literature review. In section III, Inclusive Growth and its significance for achieving sustainable growth is discussed. Section-IV brings to fore the Financial Inclusion and its dimensions in detail. In Section-V, the importance of financial inclusion for achieving Inclusive Growth in India is detailed with a statistical analysis. Section-VI contains the Recommendations and the Conclusion is presented in Section-VII.

II. FINANCE AND GROWTH

The earlier theories of development concentrated on labor, capital, institutions etc as the factors for growth and development. The leading works hardly include finance as a factor for growth. Since then there has been numerous research analyzing how financial systems help in developing economies. A wide agreement exists among economists that financial development prompts economic growth. According to Rajan and Zingales (2003), development of the financial system contributes to economic growth. Empirical evidence time and again emphasizes the relationship between finance and growth. According to the works of King and Levine (1993a) and Levine and Zervos (1998), at the cross-country level, evidence indicates that various measures of financial development (including assets of the financial intermediaries, liquid liabilities of financial institutions, domestic credit to private sector, stock and bond market capitalisation) are robustly and positively related to economic growth. Other studies also establish a positive relationship between financial development and growth at the industry level, like the one by Rajan and Zingales (1998).

Since the groundbreaking contributions of King and Levine (1993a, b), economists have shown renewed interest in the finance-growth nexus. It is indeed irrefutable that considerable part of the differences in long run economic growth across countries can be elucidated by disparity in their financial development (King and Levine, 1993a; Levine and Zervos, 1998, Demirguc-Kunt and Maksimovic (1998) and Rajan and Zingales, 1998). Beck, Demirguc-Kunt, Laeven and Levine (2006) use Rajan and Zingales (1998) approach, which provides supplementary evidence that financial development increasingly props up the growth of smaller firms which constitute largely the priority sector lending in the case of Indian Financial sector. Recent survey evidence suggests that access to finance has a direct nexus with faster rates of innovation and firm dynamism consistent with the cross-country finding that finance promotes growth through increase in productivity (Ayyagari, M., Demirgâ€¡-Kunt, A. and Maksimovic, V, 2007, Levine, 1998, 1999). Further, it has also been revealed that financial development plays a significant role in moderating the impact of external shocks on the domestic economy (Beck, T., Lundberg, M. and Majnoni, G, 2006 and Raddatz, C, 2006).

Besides debate concerning the role of finance in economic development, economists have also debated the relative importance of bank-based and market-based financial systems for a long time (Golsdmith, 1969; Boot and Thakor, 1997; Allen and Gale, 2000; Demirguc-Kunt and Levine, 2001). Joseph Schumpeter argued in 1911 that banks play a pivotal role in economic development. According to this view, the banking sector alters the path of economic progress by affecting the allocation of savings and not necessarily by altering the saving rate. Largely, the Schumpeterian view of finance and development highlights the impact of banks on productivity growth (Schumpeter, Joseph A, 1934). Banking sector can wield a positive influence on the overall economy, and hence is of broad macroeconomic importance (Bonin and Wachtel, 1999, Jaffe and Levonian, 2001, Rajan and Zingales, 1998). It is established that better developed banks and markets are closely associated with faster growth (Levine, Loazya and Beck, 2000; Loayza and Ranciere (2002); Christopoulos and Tsionas, 2004). Improved functioning of banks can be able to boost resource allocation and hasten growth (Boyd and Prescott 1986; Greenwood and Jovanovic 1990; King and Levine 1993a; Levine, R. and S. Zervous 1998). Correspondingly, by aiding risk management, improving the liquidity of assets available to savers, and by lowering trading costs; banks can enliven investment in potential economic activities (Obstfeld 1994; Bencivenga and Smith 1991; Greenwood and Smith 1997). Banks do exercise significant and causal impact on productivity growth, which feeds through to overall GDP growth. The long-run association between prioritised banking and both capital growth and private savings are more tenuous (Levine, Ross; Loayza, Norman; and Beck, Thorsten, 1999). It is also ascertained by some researchers that the size of the banking sector can be safely considered a good predictor for future growth, especially when focusing on long term projects (Andrea Vaona, 2005).

The research so far has not only looked at how finance facilitates economic activity but also social aspects like poverty, hunger etc. The consensus is that finance promotes economic growth but the magnitude of impact differs. Financial inclusion is intended to connect people to banks with consequential benefits. Ensuring that the financial system plays its due role in promoting inclusive growth is one of the biggest challenges facing the emerging economies. We therefore advocate that financial development creates enabling conditions for growth through either a `supply-leading’ (financial development spurs growth) or a `demand-following’ (growth generates demand for financial products) channel. Access to safe, easy and affordable credit and other financial services by the poor and vulnerable groups, disadvantaged areas and lagging sectors is recognised as a pre-condition for accelerating growth and reducing income disparities and poverty. Access to a well-functioning financial system, by creating equal opportunities, enables economically and socially excluded people to integrate better into the economy and actively contribute to development and protects themselves against economic shocks.

III. INCLUSIVE GROWTH

Development economists and states have often been for a long time interested in the relationship between financial development and economic growth especially in the period which is known as the era of the Washington Consensus. A growing GDP is an evidence of a society getting its collective act together for progress. As its economy grows, a society becomes more strongly organised, more compactly interwoven. Growth is good, Sustained high growth is better and Sustained high growth with inclusiveness is best of all. Inclusive growth in the economy can only be achieved when all the weaker sections of the society including agriculture and small scale industries are nurtured and brought on par with other sections of the society in terms of economic development. The major development challenge is to make the growth inclusive. Policies for inclusive growth are vital components of majority of government strategies for sustainable growth. Commission on Growth and Development notes that inclusiveness-a concept that encompasses equity, equality of opportunity, and protection in market and employment transitions – is an essential ingredient of any successful growth strategy (Commission on Growth and Development, 2008). Three pillars of inclusive growth are; (i) Maximise economic opportunities (ii) Ensure economic well being and (iii) Ensure equal opportunities to economic opportunities (Ifzal Ali, 2007). An inclusive growth strategy encompasses the key elements of an effective poverty reduction strategy and, more importantly, expands the development agenda. Developing inclusive financial systems which are financially and socially sustainable, as a poverty reduction strategy, should be given priority (Amit K. Bhandari, 2009). Levine, (1998), (1999) and Beck, Demirguc-Kunt and Levine (2007) have noticed a positive effect of finance on poverty reduction. Economies with higher levels of financial development experience faster reduction of poverty. This has been explained by an extensive body of literature including Deininger and Squire (1998), Dollar and Kraay (2002), White and Anderson (2001), Ravallion (2001) and Bourguignon (2003). In an often cited cross-country study, Kraay (2004) proves that growth in average incomes explains 70 percent of the variation in poverty reduction (as measured by the headcount ratio) in the short run, and as much as 97 percent in the long run. Lopez and Servâ€šn (2004) suggest that for a given inequality intensity, the poorer the country is, the more vital is the growth component in explaining poverty reduction. Thus, equitable growth is indeed an imperative for inclusive growth.

IV. FINANCIAL INCLUSION

Importance of financial inclusion arises from the problem of financial exclusion of nearly 3 billion people from the formal financial services across the world. The review of literature suggests that the most operational definitions are context-specific, originating from country-specific problems of financial exclusion and socio-economic conditions. Thus, the context-specific dimensions of financial exclusion assume importance from the public policy perspective. The operational definition of financial inclusion, based on the access to financial products or services, also underscores the role of financial institutions or service providers involved in the process. Furthermore, the operational definitions have also evolved from the underlying public policy concerns that many people, particularly those living on low income, cannot access mainstream financial products such as bank accounts and low cost loans, which, in turn, imposes real costs on them -often the most vulnerable people (H. M. Treasury, 2007). Thus, over the years, several definitions of financial inclusion/exclusion have evolved.

In the Indian context, Rangarajan Committee on Financial Inclusion in India (2008)) defines it as: " Financial inclusion may be defined as the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low income groups at an affordable cost." The financial services include the entire gamut – savings, loans, insurance, credit, payments etc. The financial system has to provide its function of transferring resources from surplus to deficit units but both deficit and surplus units are those with low incomes, poor background etc. By providing these services, the aim is to help them come out of poverty.

Measurement of Financial Inclusion is not universally the same. Different countries adopt different indicators to measure financial inclusion.
Definitional Aspects of Financial Inclusion / Exclusion and their indicators as recommended by United Nations, World Bank, Committee on Financial Inclusion in India (Chairman: C. Rangarajan), Asian Development Bank [ADB]

and Treasury Committee, House of Commons, UK are presented in Table-1 in Annexure-1.

Global Experiences

In the developed countries, the formal financial sector serves most of the population, whereas in developing countries, a large segment of the society, mainly the low-income group, has modest access to financial services, either formally or informally. Consequently, many of them have to necessarily depend either on their own sources or informal sources of finance, which are generally at high cost. According to Peachy and Roe (2004) developed countries have experienced good levels of inclusion (99 per cent in Denmark, 96 per cent in France, 96 per cent in Germany and 91 per cent in the USA) have bank accounts. However, it is reported that (ADB, 2007), in the developing countries, formal financial sectors serve relatively a small segment, often not more than 20-30 per cent of the population, the vast majority of who are low income households in rural areas

Recent data (Table-2 in Annexure-2) shows that countries with large proportion of population excluded from the formal financial system also show higher poverty ratios and higher inequality.

Further, it is observed that, often countries with low levels of income inequality have a propensity to have lower levels of financial exclusion, whereas high levels of exclusion are associated with the least equal ones. According to Kempson (2006), for example, While in the case of Sweden, lower than two per cent of adults did not have an account in 2000 in Germany, it was around three per cent. In comparison, less than four per cent of adults in Canada and five per cent in Belgium, lacked a bank account (Buckland et al, 2005). Countries with high levels of inequality record higher levels of banking exclusion. To illustrate, in Portugal, about 17 per cent of the adult population had no account of any kind in 2000 (Kempson, 2006).

Policy Response to Financial Exclusion – Country Experiences

The policy responses to such exclusion have been varied. Two major kinds of policy responses have been implemented by central banks in response to financial exclusion: codes of practice and specific legislation. Table-3 (Annexure-3) presents the financial inclusion initiatives in different countries. Table-4 (Annexure-4) illustrates the extent of financial inclusion in some select countries.

Initiatives for financial inclusion in India

The broad strategy for financial inclusion in India in recent years comprises the following elements: (i) encouraging penetration into unbanked and backward areas and encouraging agents and intermediaries such as NGOs, MFIs, CSOs and business correspondents (BCs); (ii) focussing on a decentralised strategy by using existing arrangements such as State Level Bankers' Committee (SLBC) and district consultative committee (DCC) and strengthening local institutions such as co-operatives and RRBs; (iii) using technology for furthering financial inclusion; (iv) advising banks to open a basic banking `no frills' account; (vi) emphasis on financial literacy and credit counselling; and (vii) creating synergies between the formal and informal segments (Thorat, 2008).

V. FINANCIAL INCLUSION AND INCLUSIVE GROWTH IN INDIA

The importance of this study lies in the fact that India being a socialist, democratic republic, it is imperative on the policies of the government to ensure equitable growth of all sections of the economy. With only 34% of population engaged in formal banking, India has, 135 million financially excluded households, the second highest number after China. Further, the real rate of financial inclusion in India is also very low and about 40% of the bank account holders use their accounts not even once a month. It is universally opined that the resource poor need financial assistance at reasonable costs and that too with uninterrupted pace. However, the economic liberalization policies have always tempted the financial institutions to look for more and more greener pastures of business ignoring the weaker sections of the society. Some of the features of financial exclusion in India are captured in Figure-1 (Annexure-12).

It is essential for any economy to aim at inclusive growth involving each and every citizen in the economic development progression. It is in this context that a study has to be made to understand the importance of priority sector lending in ensuring the inclusive growth in the Indian context. Select macro-economic and financial indicators of Indian economy are presented here below in Table-5 (Annexure-5).

Analysis

Based on the well accepted approaches for evaluation of the coverage of financial inclusion and to assess its impact on inclusive growth the study endeavors to analyse the following:

Spatial Distribution of banking Services

Regional Distribution of Banking Services

Impact of Financial Inclusion on Inclusive Growth

1. Spatial Distribution of banking Services

In order to analyse the spatial distribution of banking services in the country, data for the periods 1991 and 2005 has been verified. Further, bank offices in the country have been classified into Rural and Urban areas. This has been considered in order to get a clear understanding about how the spread of formal banking services has been affected in different parts of the country. The total number of saving accounts, considered to be a better indicator of banking penetration than other deposit accounts, as per cent of number of households, was 137 in rural areas and 244 in the urban areas on the eve of reforms in 1991. By 2005, despite the reforms, the differential continues to be similar. In the case of credit accounts, the situation have deteriorated for rural households while showing significant improvement in the urban areas (Table-6 in Annexure-6), corroborating the very significant increase in retail credit.

2. Regional Distribution of Banking Services

An effort has been made to analyse the extent of financial inclusion in different regions of the country such as Northern, North-Eastern, Eastern, Central, Western and Southern regions apart from All India level. A purposeful analysis is made by comparing the data for the period from 1991 to 2005. Further, this data has been further split into rural and urban areas in the country in order to get an exact view about the distribution services in these areas. Further, the analysis is made in terms of population coverage per bank office, Number of Savings accounts per population of one hundred and Number of Credit (loan) accounts per population of one hundred. Table-7 (in Annexure-7) captures the data related to Financial Inclusion, Poverty levels, Population density and Literacy. Table-8 (in Annexure-8) presents the data related to Bank Branches, Workers, Population of Scheduled Castes and Percentage of Households with bank accounts in India. This data is largely sourced from the website of Census India and Reserve Bank of India publications.

In terms of financial broadening, the scope for improvement remains. Table-9 (in Annexure-9) illustrates the level of financial inclusion in India with region wise statistics. It is discernible that Southern and Northern regions have population coverage below the national averages. All the other regions in the country have coverage well above the national average calling for urgent improvement in the population coverage of the population. Again in terms of rural and urban areas there has been a distinct progress in the coverage of the population by the bank branch offices.

Table-9 provides further clarity by providing a break-up of the deposit accounts. Both the deposit and credit accounts are lower in rural households than urban households. Hence despite the rural-push, the rural population has not come forward and avail even basic banking services

Impact of Financial Inclusion on Inclusive Growth

In order to involve a comprehensive measure of financial inclusion in the Indian context, we consider Priority Sector Lending as a measure of financial inclusion. We are of the opinion that, mere opening of bank account would not be a true indicator of financial inclusion, but availment of financial services, more importantly; the much needed credit for the excluded sections of the society would definitely depict the measure of financial inclusion. Further, this measure would meet the requirements of the definition for measurement of Financial Inclusion provided by United Nations, wherein it is said that the indicator should measure the " Access to credit, insurance, savings and payment services". Priority Sector Lending as an indicator in our study addresses all the above aspects. In view of this an attempt has been made to establish the relationship of priority sector lending (as a measure of financial inclusion) with the indicators of inclusive growth such as rural poverty. Rural poverty is considered to portray inclusive growth as more than 70 percent of India lives in rural areas.

The required data for the analysis is obtained largely from the most reliable and official sources such as Reserve Bank of India website, NABARD website, India Development Report 2008 and other related sources. Economic Reforms in Indian economy were initiated in the year 1991-92. As such, to cover equal number of years of priority sector lending and inclusive growth during pre and post-Liberalisation period, data for the period from 1974-75 to 2007-08 has been analysed for understanding the trends. For the purpose of analysis the most popular statistical measure Multiple Regression (OLS) Analysis is used (Andrea Vaona, 2005, Andrea Vaona and Roberto Patuelli, 2008 have also used the same kind of analysis for similar studies).

The objective of this section of the paper is to recognize the determinants of Inclusive Growth which can be captured in Rural Poverty (RU_POV) (measured in percentage against that of the total population in rural areas and these figures are provided by the Census of India data) in India and ascertain the impact of Priority Sector Lending (PSL) on rural poverty in India. Priority Sector Lending in the Indian context refers to the bank credit under the directed lending towards the private firms and individuals which is an important parameter that determines the measure of development that can significantly contribute to inclusive growth (Andrea Vaona, 2005). Domestic Savings (SAV) (measured in Rupees in Crores) is included as a determinant in order to account for the argument that savings propels economic activity in the system at large and helps in inclusive growth process (Beck, Levine and Loayza 2000). Rural Employment is one of the significant measures of economic development and consequently of inclusive growth. A greater level of rural employment can be taken as evidence of greater economic development (Cole Shawn, 2007). In recognition of this argument, Employment in Rural Primary sector (EMP_RP) (expressed in million numbers) is included as one of determinants to study their impact on inclusive growth. Agricultural Production is another important determinant that affects the inclusive growth process in rural India. As a large population of weaker sections of the society still depends to a large extent on agriculture, Agricultural Production (AGRI_PRO) (expressed in Kilograms/hectare) determines their upward movement in the income ladder (Andrea Vaona, 2005 also considered production as an important variable in a similar study). Accordingly, agricultural production is also considered as a determinant in the analysis. There is also an indisputable argument that overall credit has profound impact on inclusive growth process (Andrea Vaona, 2005). In view of this, Credit to Gross Domestic Product (CRED_GDP) (measured as a ratio in percentage to GDP) is included as a determinant. If there is an increase in Per Capita Income (PCI) (measured as per capita NNP at factor cost expressed in Crores in Rupees) there certainly will be an increase in inclusive growth process. As such, Per Capita Income (as used as a determinant in a similar analysis by Andrea Vaona and Roberto Patuelli, 2008, Srinivasan 1994, Streeten 1994, and Sugden 1993) is commonly accepted measure of standard of living of people and consequently is a major factor that enhances inclusive growth and hence it is included in the analysis.

The regression model can be;

Y = à + á1X1 + ….. + ánXn + æ ——->

Accordingly, Rural Poverty can be better explained and estimated with the following version of equation;

RU_POV = f (PSL, SAV, EMP_RP, AGRI_PRO, CRED_GDP, PCI) + æ ——>

In order to control for other factors associated with economic growth not linked to financial development, the regression results are presented by using a simple conditioning information set, including the constant, the logarithm of all explanatory variables. Due to potential nonlinearities, the natural logarithms of the regressors are considered (Levine, Loazya and Beck, 2000).

Accordingly, when we log-transform this model (also called a log-log, double-log) we obtain:

Log (RU_POV) = à + log (PSL, SAV, EMP_RP, AGRI_PRO, CRED_GDP, PCI) + æ

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`à' represents the `Y intercept', á1,…? n represent the respective regression coefficients for explanatory variables X1 .. Xn and `æ' represents the error term. Where, `Y' represents the `RU_POV' , i. e, Rural Poverty and `X1′, `X2′ , …., `X14′ represent the predictor variables and `á1′ , `á2′, ….., `án' represent the partial regression coefficients of `PSL' i. e, `Priority Sector Lending', `SAV'-Savings, `EMP_RP'-Employment in Rural Primary sector, `AGRI_PRO'-Agricultural production, `CRED_GDP'-Credit to Gross Domestic Product and `PCI'-Per Capita Income respectively. `æ' represents the `error term'. The results of analysis are presented in Table-10 (Annexure-10) for the period from the year 1977 to 2007. Inferring from the results of this analysis, it can be concluded that Priority sector lending has significant impact on rural poverty.

Graphical presentation of the trend of priority sector lending in the pre liberalisation period from 1974-75 to 1990-91 and post liberalisation period from 1991-92 to 2006-07 is illustrated in Figure-2 (Annexure-13). It is clearly evident from the figure that priority sector lending has taken a gradually upward moving curve indicating a steady rise in the post liberalisation era. Further, the Nature and strength of the impact of the various determinants on Inclusive growth are captured in Table-11 (Annexure-11). A graphical presentation of the trend of the inclusive growth in India is presented in

Figure-3 (Annexure-14). It is orchestrated by the rhythmic forward movement trends of the above discussed determinants during the study period. Rural Poverty is on a declining trend more pronouncedly during the post liberalisation period.

Findings of the Study

The study found that Priority Sector Lending has a very high significant impact on inclusive growth, which is in line with the findings of Kraay (2004) and Beck, et all (2007). Domestic Savings (in line with the conclusions of Levine, Ross; Loayza, Norman; and Beck, Thorsten, 1999), Credit to Gross Domestic Product (as established by Ayyagari, M., Demirgâ€¡-Kunt, A. and Maksimovic, V, 2007, Narasimham, 2002, Obstfeld 1994; Bencivenga and Smith 1991; Greenwood and Smith 1997) and Per Capita Income (as stated by Levine, 1998, 1999) are found to have significant impact on reducing rural poverty in India. The model developed in the study explains the trend of rural poverty (Lopez and Servâ€šn, 2004) to the extent of 93. 5 percent involving the important determinants such as Priority Sector Lending (Rajan and Zingales 1998), Savings, Employment in Rural Primary sector, Agricultural Production (Andrea Vaona, 2005), Credit to Gross Domestic Product (Andrea Vaona, 2005) and Per Capita Income (Andrea Vaona and Roberto Patuelli, 2008, Srinivasan 1994, Streeten 1994 and Sugden 1993). Further, it is also demonstrated (Figure-2) that financial sector reforms have indeed had a positive impact on reduction of rural poverty.

VI. RECOMMENDATIONS AND POLICY CHOICES

Based on the outcome of the above analysis, we present here below our recommendations.

Strategize the Provision of Bank Credit

Need is felt to strategize the provision of bank credit to the rural farmer households. Majority of the marginal farmer households are not at all covered by the formal finance. As such public sector banks and the co-operative banks in the rural areas have to sensitize about the need for provision of timely and cheaper credit to these segments. Reserve Bank of India in consultation with NABARD should come out with a comprehensive strategy for revitalizing the quiescent rural credit mechanism.

Cover the Poor

It is imminent to encompass the tenant farmers, oral lessees and share croppers, marginal farmers with small un-economical land holdings, agricultural laborers, rural artisans and people involved in making handicrafts and also majority of weavers in handloom Sector.

Extensive use of Co-operatives

The large number of PACS and primary cooperatives under the parallel Acts located in rural areas are not functioning effectively. Many of these cooperatives are in districts where the DCCBs are defunct or moribund. Such PACS could provide valuable services to their members if they get access to a commercial bank. In view of these there is a need to revitalize these cooperatives as per the Vaidyanathan Committee recommendations and use them extensively for financial inclusion in the rural areas.

Undoubtedly a Greater Role for NABARD

NABARD ha to play a pro-active role by partnering with the rural credit institutions in the field and identify new initiatives that will contribute to effectively improving the extent of financial inclusion involving SHGs, MFIs, etc.

Procedural / Documentation Changes

It is inevitable on the part of the regulators to find out an easy way of procuring the documents for opening of bank accounts and availing loans. The present guidelines are more tedious and result in huge costs for the poor in accessing the banks for any kind of services. Exemption from Stamp Duty for Loans to Small and Marginal Farmers, Simplifying Mortgage Requirements, Saral Documentation for Agricultural Loans.

Proactive Role of Government

State Governments should asked by the Centre to play a pro-active role in facilitating Financial Inclusion. Issuing official identity documents for opening accounts , creating awareness and involving district and block level functionaries in the entire process, meeting cost of cards and other devices for pilots, undertaking financial literacy drives are some of the ways in which the State and district administration have involved themselves.

A role for Rural Post Offices

Post Offices in rural areas can be asked to provide their services in accelerating the financial inclusion activity. In view of the postman’s intimate knowledge of the local population and the enormous trust reposed in him post offices can be good use in the process of financial inclusion

Effective use of Information Technology Solutions

Financial Inclusion initiatives.

Adequate Publicity for the Project of Financial Inclusion

In a huge country like India, there needs to be huge publicity for popularizing the concept and its benefits to the common man. In this direction, a comprehensive approach has to be developed involving all the concerned at all levels to impress upon the need for financial inclusion for accelerating th