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Evaluating the Socio-Economic Sustainability of Microfinance Institutions through System Dynamics Approach

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Abstract

Financial services in India are majorly offered by Banks, Non-Banking Financial Companies, and Microfinance Institutions which serve the rural and urban communities providing them financial aid to run their day-to-day business needs. But, these financial institutions specifically Microfinance Institutions, as they are known to serve a major chunk, need to be well-networked and more sustainable. This study attempts to analyse the sustainability of Microfinance Institutions within economic and social contexts. The objectives undertaken of this study are to identify the sub-factors impacting the economic and social performance of Microfinance Institutions and to assess how these socio-economic performances of Microfinance Institutions impact their overall sustainability. The methodology used to justify these objectives is Systems Dynamics Modelling technique which includes building a model as a Causal Loop Diagram showing positive or negative relations of the considered variables. The results obtained by the empirical study show the positive impact of the economic and social sustainability of Microfinance Institutions on their overall sustainability. The conclusions imply the managerial and future implications of the study highlighting the need to promote the economic and social performance of Microfinance Institutions so that their overall sustainability can be improved. This also helps Microfinance Institutions enhance their profitability margins and develop social boundaries along with contributing to economic development and growth of the economy.

Keywords: Causal Loop Diagram, Microfinance Institutions, Simulation, Stock Flow Diagram, System Dynamics.

Introduction

Global changing needs of the industries have led to economic development across the countries. Thus, there is huge need to inculcate sustainable development within the economies. This concept of sustainable development talks about major three aspects: financial development, economic development and social development. Although, microfinance plays a major role contributing in sustainable development of the economy, thus sustainability of institutions providing microfinance services (like Microfinance Institutions) is also important. Since, these microfinance institutions contribute to the socio-economic development, their social and economic performance needs to be well analysed (1). Microfinance is considered to eliminate poverty and it is also agreed that the microfinance is considered to have a positive relation with consumption expenditure when loans are taken by women borrowers (2). Microfinance powered by Microfinance Institutions which offer range of financial products and services to the deprived sections of the society especially, to the vulnerable women and small businesses to manage their business cycles (3, 4). The paper's arrangement delineates the introduction and implications for the microfinance sector. Subsequent sections offer justification for the literature review. The sections following the review comprise a theoretical model, research methodology, findings, and implications for the future.

Microfinance from Socio-Economic Viewpoint

Microfinance supports social development by addressing and resolving social issues about women in society in various spheres of society (5). In contrast, it supports economic development by bringing structural changes since it addresses low-income households (6). It enables the sustainability of economic growth, which encourages the implementation of the triple bottom-line strategy, which integrates financial, social, and environmental aspects, is perceived as sustainable development. The existence of sustainable economic development is favoured

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when the local and national setup adopts green and sustainable approaches (7-9). Hence, microfinance becomes sustainable when microfinance institutions adopt these sustainable practices. Microfinance Institutions encourage sustainable practices through services such as money transfer, microcredit, micro insurance, and micro savings. In that context, microfinance can be viewed as a financial means offered to support sustainable economic growth or green growth (10, 11). Eventually, it helps poor communities sustain themselves and let them nurture such aspirational small companies through micro financing. Sustainable development is a holistic approach which regards interconnection between the economy, society, environment, governance, and technology on one hand, and social and economic factors on the other (12-15). Microfinance fosters socio-environmental relations viewed through the prism of gender equity and environmental issues (16). In order for microfinance to act solely as a vehicle of sustainable development, regulations and changes therein concerning the interplay between financial performance and governance will need to be fully understood (17, 18). Microfinance institutions are primarily characterized by their social-economic dimensions that incorporate diverse factors such as the number of borrowers, range of products offered, financial conditions of clients, a specific focus on women borrowers, total number of loan recipients, and costs of service delivery for microfinance and related services (19). Microfinance started as an intervention for the United Nations Millennium Development Goals (MDGs), which were set to be fulfilled by 2015, and later included in the 2030 Sustainable Development Goals (SDGs) (20). Among other research findings, this suggests that access to renewable energy sources together with microfinance development with sustainable and poverty alleviation (21).

Microfinance Institutions face multiple challenges in balancing financial sustainability and poverty alleviation goals (22). Factors affecting Microfinance Institutions' financial viability were studied in Sri Lanka. Financial self-sufficiency and operational self-sufficiency are regarded as two preconditions for sustainable Microfinance Institutions (23-25). One definition of operational efficiency is when a Microfinance Institutions covers all of its operating expenditures from its own income, regardless of financial assistance (26). Over time, Microfinance Institutions that attain financial self-sufficiency are better able to sustain their operations without resorting to external means of support (27). The operating costs ratio and capital structure have an inverse relation to financial sustainability, while a variety of factors bring about its positive influence: productivity of loan officers, the age of Microfinance Institutions, type of organization, profit margin, clientele numbers, interest rate competitiveness, average loan sizes, judicious cost control, monitoring processes, and loan recovery mechanisms (28).

In this study, socio-economic sustainability reflects how Microfinance Institutions (MFIs) are able to not only maintain financial health over time but also contribute meaningfully to social progress. It captures their capacity to support economic growth, such as job creation and profitability while also promoting inclusion, especially among underserved and marginalized communities. This concept is viewed through two interconnected dimensions: economic sustainability and social sustainability.

This study seeks to test these two environments affecting the sustainability measurements independently. Economic and social factors have divergent sets of factors, some more affecting than the others. The factors that are relevant in this analysis should be understood, which are as follows:

Microfinance institutions' (MFIs) economic sustainability is determined by a few key factors:

- Number of Microfinance Institutions (NMFI): The total count and spread of MFIs across India, especially in underserved rural areas, which boosts financial awareness and access, strengthening economic sustainability.
- Employment Generated (EG): Jobs created by MFIs through affordable loans to small businesses, directly supporting economic growth and sustainability.
- Microfinance Institutions Outreach (MFIO): The reach of MFIs to serve clients; broader outreach means more people benefit, increasing their impact and sustainability.
- Profitability (Pr): The ability of MFIs to earn profits beyond their costs, which

reflects stronger economic health and performance.

- Contribution to GDP per capita (CGDP): The positive impact MFIs have on the regional economy by contributing to overall economic output, supporting both their sustainability and the broader economy.

The factors which contribute to the social sustainability of Microfinance Institutions include:

- Percentage of Female Borrowers (PFB): The share of women among MFI clients, which empowers women and improves the social impact of these institutions.
- Female Entrepreneurship (FE): The proportion of female borrowers who are entrepreneurs, indicating stronger social contributions from women-led businesses.
- Socially Backward Groups (SBG): Inclusion of marginalized communities as borrowers, reflecting MFIs' role in promoting social equity.
- Percentage of Female Employees (PFE): The share of women working in MFI-supported businesses, showing female participation in the workforce and boosting social performance.
- Rural Clients (RC): The number of rural borrowers accessing MFI services, helping reduce urban-rural financial gaps and promote inclusive development.
- Income Generation Loans (IGL): The portion of loans actually used for income-generating activities, which ensures effective use of funds and supports both social and financial sustainability.

The Table 1 below shows the factors identified from the literature survey that impact economic and social Microfinance Institutions:

Table 1: The Factors Identified That Impact Economic and Social Microfinance Institutions

Perspectives	Factors Contributing Each Perspective	Source
Economic Performance	Number of Microfinance Institutions in India (NMFI)	(29)
	Employment Generated (EG)	(30)
	Microfinance Institutions Outreach (MFIO)	(31)
	Profitability (Pr)	(31)
	Contribution to Gross Domestic Product per capita (CGDP)	(32)
Social Performance	Percentage of female borrowers (PFB)	(33)
	Female Entrepreneurship (FE)	(34)
	Socially Backward Groups (SBG)	(30)
	Percentage of Female Employees (PFE)	(29)
	Rural Clients (RC)	(35)
	Income Generation Loans (IGL)	(30)

In examining the interplay between the enhancement of Microfinance Institutions' economic and social performance on the strength and sustainability of Microfinance Institutions, this research adds to the body of literature. Similarly, these findings have important managerial implications for Microfinance Institutions to expand their client base, entry into new markets, and profitability. The novelty of this study is that most of the prior research has worked either on economic performance or on social performance of Microfinance Institutions in isolation. This study is designed to explore the key factors that influence the economic and social performance of Microfinance Institutions (MFIs) and how these contribute to their overall sustainability. It aims to uncover the main economic drivers such as profitability, outreach, and employment generation. Additionally, it seeks to understand important social aspects, particularly the role of women's entrepreneurship and the inclusion of clients from rural areas. By bringing these elements together, the research hopes to offer insights into what supports the long-term viability of MFIs.

Methodology

The goal of this study is to combine the two sustainability frameworks and assess their respective effects and their interrelations. The Figure 1 below shows the model developed to show the interrelations of the identified variables with their respective dimensions and collectively to the overall sustainability of Microfinance Institutions.

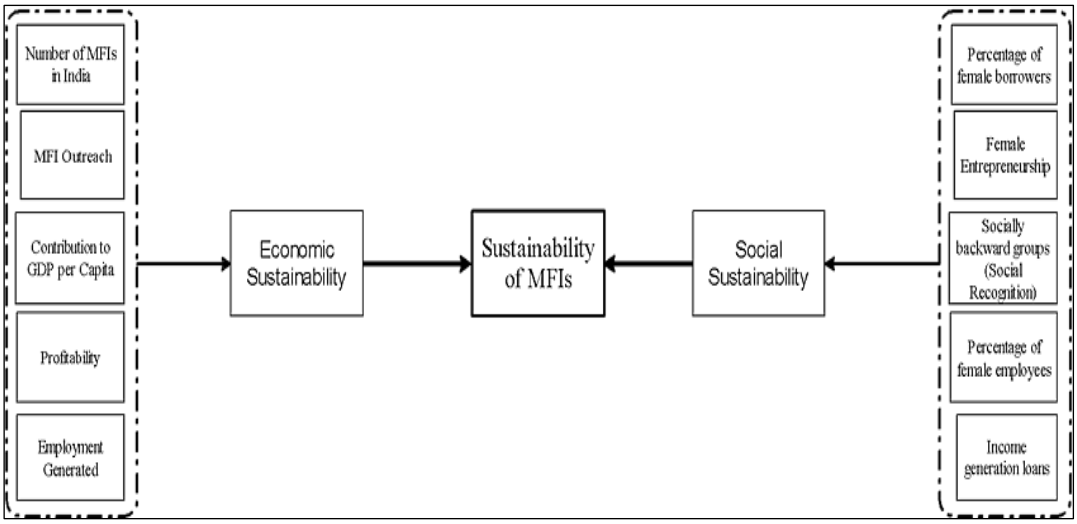

Figure 1: Theoretical Model for Sustainability of Microfinance Institutions

This research adopts a systems dynamics modelling framework to explore how Microfinance Institutions (MFIs) in India sustain themselves over time, particularly through their economic and social dimensions. The methodology combines structured data analysis with simulation techniques to understand the behaviour of key influencing factors in a dynamic environment. The variables selection and data collection are done to be put to model. Within the framework of the systems dynamics modelling technique, this paper discusses both social and economic performance. This approach clarifies the relationships amongst the parameters considered and assesses microfinance as a holistic ecosystem and that is why this study used systems dynamics in relation to socio-economic sustainability context.

The overall approach can be outlined in the following phases:

Step 1: Model Construction and Design

The variables finalized for the study are constructed into a theoretical model. A Causal Loop Diagram (CLD) was created to visually represent the interconnections between them. This diagram served as a conceptual blueprint, highlighting whether the relationships were positively or negatively reinforcing. It enabled a better understanding of how changes in one variable could ripple through the system. The Figure 2 below shows the Causal Loop Diagram for the study:

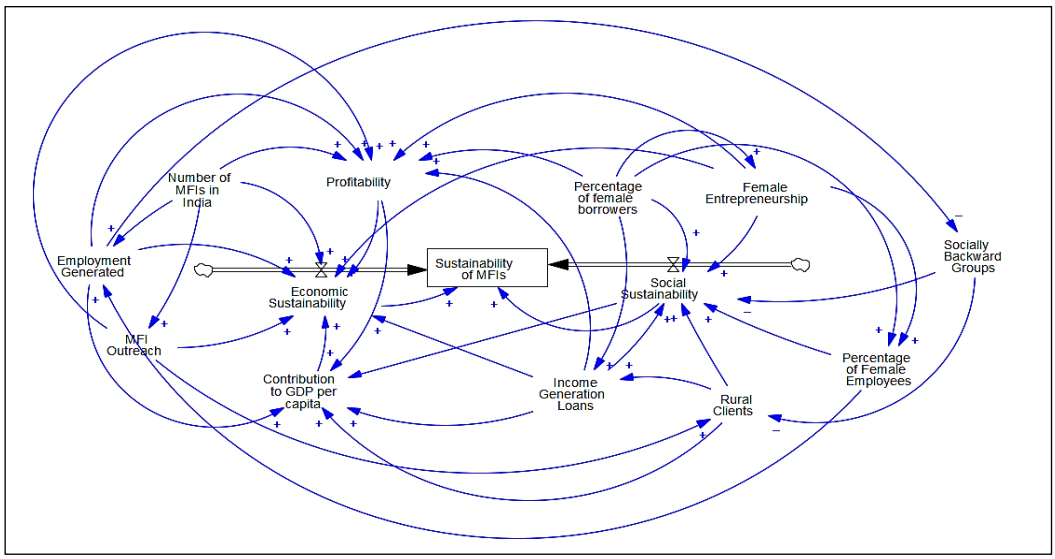

Figure 2: Causal Loop Diagram of the Factors Contributing to Economic and Social Sustainability

The CLD was then translated into a Stock Flow Diagram (SFD) using Stella Architect 3.0. This transition allowed for the development of a functional simulation model that could track how different elements accumulate or flow over time. In the model, social and economic sustainability were treated as flow variables, while overall MFI sustainability was represented as a stock variable that aggregates the impacts of both.

Step 2: Mathematical formulation and parameterization

An SFD gets transformed into a mathematical equation assigning values to all variables for integration into the equation.

Overall sustainability of Microfinance Institutions = Economic Sustainability + Social Sustainability + Remaining impacting factors

the sustainability of the microfinance institutions (Microfinance Institutions) depends on the economic as well as social performance of the institutions (36, 37). In this context, the residual factors constitute the error term and represent those variables not accounted for in this study.

starting from initial values of zero {0}. Each variable is given a value according to the formula from past study (38). The mean, standard deviation, and variance values are derived from the acquired dataset.

Value of variable = Mean * Std. Deviation / Variance

Step 3: Model Simulation

With the model set up, simulation experiments were carried out using Stella Architect. The simulation was run for 100 cycles, which is generally considered sufficient for observing stable trends in system behaviour. During each cycle, the model evaluated how changes in the input variables influenced both economic and social sustainability, and subsequently, the overall sustainability of MFIs. The simulation helped uncover trends over time, especially how slow-moving or "delayed" variables like institutional outreach or changes in borrower demographics eventually shape system-wide outcomes.

Step 4: Calibration and Validation

As stated in this paper, the sub-parameter's initial condition has been set to zero (0). In addition, starting conditions for economic and social sustainability are defined by the summation of their own parameters. Validation results of the present work indicated that the results obtained by the systems dynamics modelling correlate well with the findings of past studies on the parameters examined, namely, Number of Microfinance Institutions in India (NMI), Employment Generated (EG), Microfinance Institutions Outreach (MFIO), Profitability (Pr), Contribution to Gross Domestic Product per capita (CGDP), Percentage of Female Borrowers (PFB), Female Entrepreneurship (FE), Socially Backward Groups (SBG), Percentage of Female Employees (PFE), Rural Clients (RC), and Income Generation Loans (IGL).

Step 5: Sensitivity Analysis

To ensure the robustness of the model and understand the relative influence of specific variables, a sensitivity analysis was performed. Two variables were selected for this purpose due to their strong systemic influence:

- Number of MFIs in India (NMFI)
- Percentage of Female Borrowers (PFB)

These variables were gradually increased in the model to observe their isolated and combined effects on overall sustainability. The results showed that while both variables positively influence sustainability, their impact unfolds over time due to their role as structural drivers or delayed converters in the system.

Step 6: Model Evaluation and Validation

The validity of the developed system dynamics model was assessed by comparing its simulated outputs with historical trends reported in secondary data sources spanning the years 2015 to 2023. The data were sourced from institutional publications such as the Reserve Bank of India (RBI) Annual Reports, NABARD Status of Microfinance Reports, the India Brand Equity Foundation (IBEF), and the Bharat Microfinance Reports. These sources have consistently tracked key performance indicators of MFIs such as outreach, profitability, and employment generation. For instance, the upward trend in employment generated through micro-enterprises supported by MFIs, as observed in NABARD's 2018–2022 microfinance reports, aligns with the simulation output that employment generation

contributes positively to economic sustainability (39). Similarly, the steady rise in the percentage of female borrowers, especially after the promotion of financial inclusion schemes like Jan Dhan Yojana and Stand-Up India, mirrors the model's assumption that female participation improves social sustainability (40, 41). Additionally, the model's structure linking variables such as profitability, outreach, and client diversity to sustainability echoes findings in prior empirical studies. For example, it is emphasized the role of female borrowers and rural outreach in strengthening the social impact of MFIs in India, while a study demonstrated how financial indicators such as operational self-sufficiency and loan portfolio size affect long-term viability (42, 43). These conceptual alignments further validate the theoretical robustness of the model.

Results

Sustainability of microfinance institutions has become thoroughly important in order to attain client reach till the root level. The results of the simulation study conducted analysed that the parameters like Number of Microfinance Institutions in India when enhanced; it can positively impact the economic sustainability. The Number of Microfinance Institutions in India here acts as a delayed parameter as it might take longer span for new Microfinance Institutions to establish and the total number of existing plus new Microfinance Institutions to increase. Similarly, the Employment Generated also tends to positively impact the economic sustainability as employment generated enhances the economic growth within an economy. Microfinance Institutions Outreach, another parameter tends to positively impact the economic sustainability of Microfinance Institutions. Similarly, Contribution to Gross Domestic Product per capita tends to impact the economic sustainability of Microfinance Institutions in positive manner. These all are the major impacting factors that contribute to the economic sustainability of Microfinance Institutions.

On the similar lines, the factors that impact the social sustainability of Microfinance Institutions are percentage of female borrowers which positively impact social sustainability as more the female borrowers, the presence of female contribution will increase within the economy, reducing the gender disparity within the society. Similarly, percentage of female employees also tends to increase the social sustainability. Female entrepreneurship tends to increase the social sustainability as more the female entrepreneurship better is the female contribution in the society. Rural Clients tends to positively impact the social sustainability as the number of rural clients increase with Microfinance Institutions better is the financial inclusion so better is the social sustainability of Microfinance Institutions. Income generation loans on the other hand, tend to positively impact the social sustainability of Microfinance Institutions. Lastly, socially backwards groups are another parameter that tends to impact the social sustainability of Microfinance Institutions. But this parameter tends to negatively impact the social sustainability. This is due to the reason that more the number of socially backward groups less are their contribution to financial inclusion within the economy.

These parameters besides impacting the economic sustainability and social sustainability of Microfinance Institutions individually, still they also do interrelate to each other and impact each other internally. The number of Microfinance Institutions increases can also lead to increase in employment generated. Number of Microfinance Institutions in India also impacts the Microfinance Institutions Outreach which means that if number of Microfinance Institutions increase, the Microfinance Institutions Outreach particularly the Microfinance Institutions presence in rural and urban areas will increase. Employment Generated parameter on the other hand, impacts profitability of the Microfinance Institutions in positive way. Though, employment generated leads to more people employed, it also contributes to increase in contribution to Gross Domestic Product per capita. The employment generated leads to decrease the socially backwards groups thus tends to share a negative relation with it. The employment generated overall leads to increase in profitability of Microfinance Institutions as well. The profitability of Microfinance Institutions is dependent on number of other factors like Microfinance Institutions Outreach, female entrepreneurship, percentage of female borrowers, and income generation loans. It signifies that if Microfinance Institutions Outreach

increases the presence of Microfinance Institutions within the economy increases leading to increase in profitability of Microfinance Institutions in India. Also, if percentage of female borrowers increase and thus also the female entrepreneurship increases leads to increase in profitability base of Microfinance Institutions as it is agreed within literature that female borrowers tend to be more credible and trustworthy than male borrowers (44) and they can manage loan repayment schedules better. For this same reason, female entrepreneurship tends to positively impact the economic sustainability of Microfinance Institutions too. On the similar lines, it can be said that, increase in percentage of female borrowers will lead to increase in percentage of female employees as entrepreneurship positions more held by female authorities will definitely hire more female employees. More the female employees are hired, more is the employment generated. Similarly, the loans which generate good income benchmarks tend to increase the profitability of Microfinance Institutions. Income generating loans also tends to enhance the economic sustainability of Microfinance Institutions as more income generating loans can lead to better economic margins ultimately benefiting economic sustainability of Microfinance Institutions. The income generating loans is in turn impacted positively by the rural clients which signifies that more the number of rural clients of Microfinance Institutions more will be the income generating loans within the Microfinance Institutions. The rural clients will be more if socially backward groups will be more. The rural clients if more leads to contribute more towards Gross Domestic Product per capita.

These above-mentioned relations are tested using simulation model run analysis of systems dynamics modelling technique. The causal loop is extended to stock flow diagram and further simulation run is done to understand the movements over the graphs. The below shows the SFD:

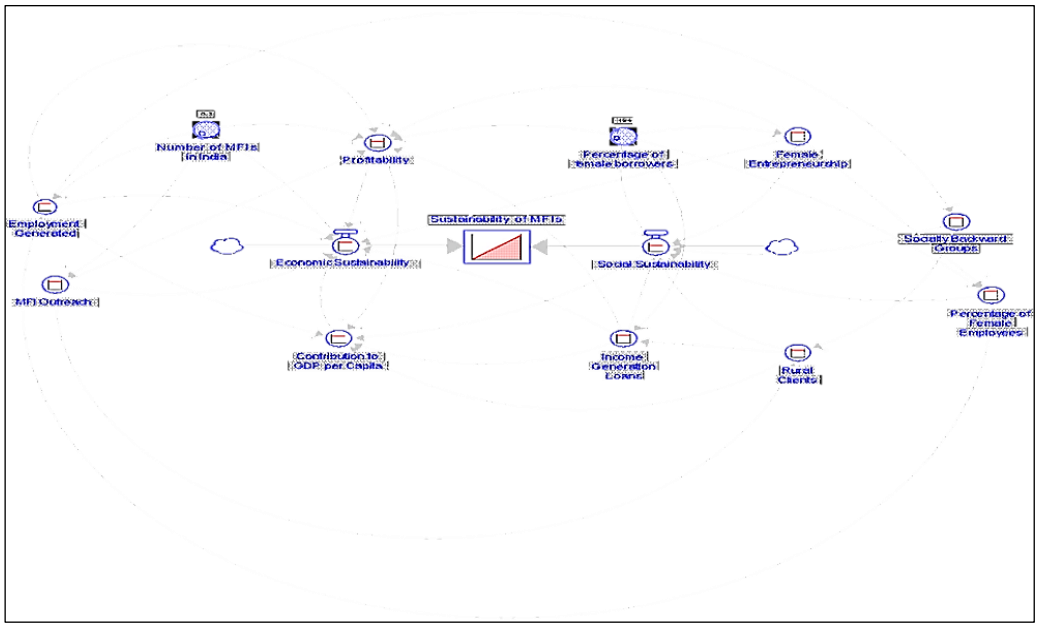

Figure 3: Stock Flow Diagram of Sustainability of Microfinance Institutions

The diagram above in Figure 3 depicts a simulated run-based system dynamics model of how the sustainability of Microfinance Institutions is dependent on their single economic and social performance. This study looked into how Microfinance Institutions sustainability relates to the economic and social performance of Microfinance Institutions, whereby all these performances are directly dependent upon the modifications of their respective sub-variables. The following equation describes the separation of individual economic and social performance for each Microfinance Institutions from overall sustainability:

$$EP(y) = \int_0^y \{0.851NMFI + 1.27EG + 3.82MFIO + 1.81Pr + 9.8CGDP\} \quad \text{... [1]}$$

$$SP(z) = \int_0^z \{79.5NFB + 0.345FE + 3.84SBG + 17IGL + 3.62\,RC + 2.77PFE\} \quad \text{... [2]}$$

$$SMFI = ES + SS \ldots\ldots\ldots [3]$$

The above three equations when brought to find the sustainability of Microfinance Institutions form the equation below:

Where, SMFI = Sustainability of Microfinance Institutions

EP = Economic Sustainability

SP = Social Sustainability

Thus, the equation for the sustainability of Microfinance Institutions becomes as:

$$SMFI(t) = \int_0^t \{17.6EP + 107SP\} + \text{Ɛ} \quad \ldots [4]$$

Where Ɛ = residual term depicting error.

Using these relations, a simulation run is conducted which includes the optimization and payoff run for all the parameters (independent and dependent) involved within the study. The simulation is done by keeping a fractional length of 5 cycles which are repeating on a total cycle time of 0-100. The above plot shows the normal probability distribution plot of the sustainability of Microfinance Institutions which is bifurcated into 4 quartiles such as 1/4th (25), 2/4th (50), 3/4th (75), and 1(100). The main varying parameters considered for the payoff and calibration runs are Number of Microfinance Institutions in India and Percentage of Female Borrowers. These two parameters are only considered as these two act as delayed converters within the study and also varying their parametric values steadily can impact the dependent variable significantly.

Now, the sensitivity run is conducted which means that the values of the varying parameters are gradually increased to check the impact on dependent variable. Thus, the Number of Microfinance Institutions in India is gradually increased to double at first keeping all other parameters constant to check the impact on economic sustainability, social sustainability and overall sustainability of Microfinance Institutions. This relation can be predicted from diagrammatic and graphical representation as shown below:

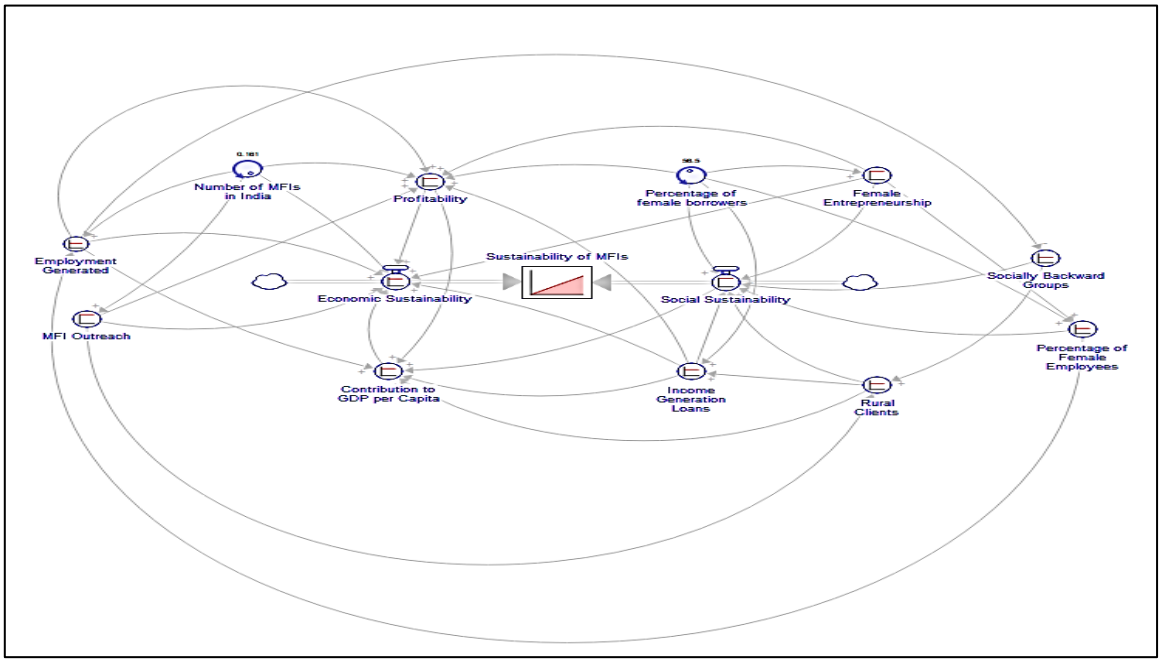

Figure 4: First Sensitivity Run for the Model

The above shown Figure 4 shows the first sensitivity run where the parameters are kept constant and the results shows that the economic sustainability, social sustainability, number of Microfinance Institutions in India and the percentage of female borrowers are all constant maintaining a linear relationship with the sustainability of Microfinance Institutions. Within the Run 2, the NMFI is increased to double to check the sensitivity analysis. The Stock Flow Diagram below Figure 5 shows the same:

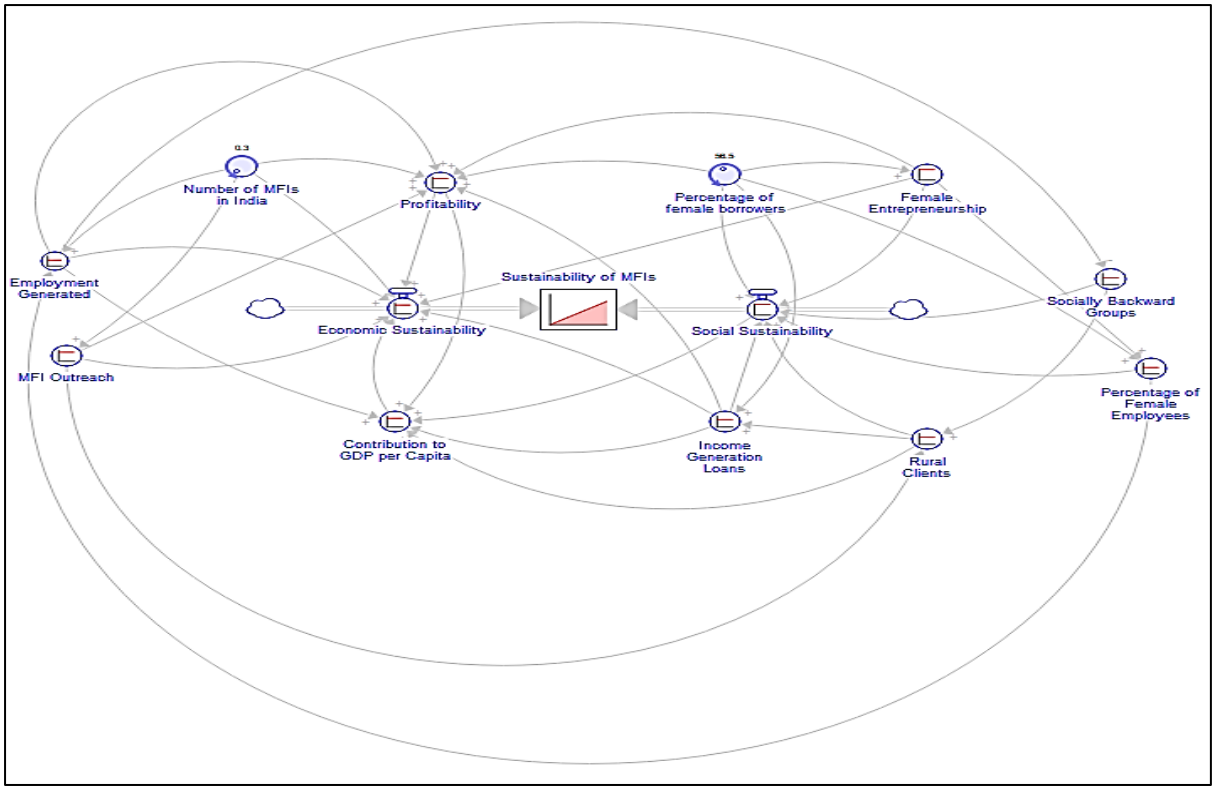

Figure 5: SFD for Run 2 for Sensitivity Analysis

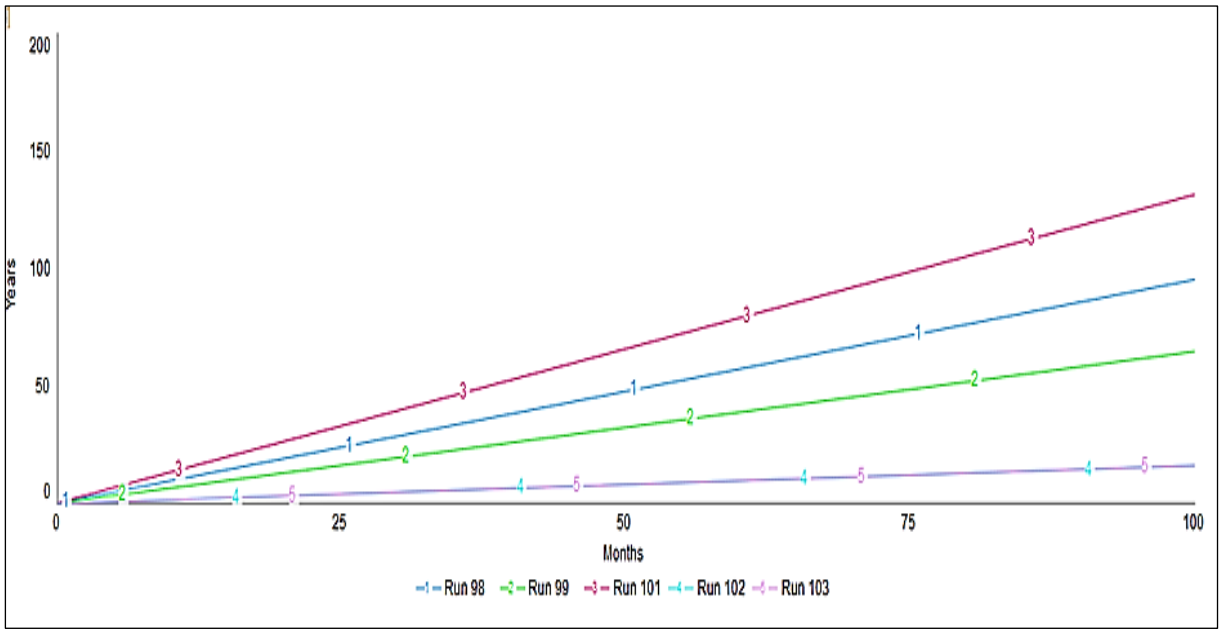

Figure 6: Sensitivity Run for Number of Microfinance Institutions in India for Run 2

The results from Figure 6 demonstrate how an increase in the Number of MFIs in India (NMFI) positively affects the system's economic sustainability. This trend is more clearly observed in Figure 7, where economic sustainability increases steadily. These outputs support the model's assumption that institutional expansion contributes directly to employment generation, broader outreach, and financial access, though key elements of economic sustainability identified in the study. The consistent upward curve reflects the gradual but cumulative impact of increased MFI presence on economic outcomes over time.

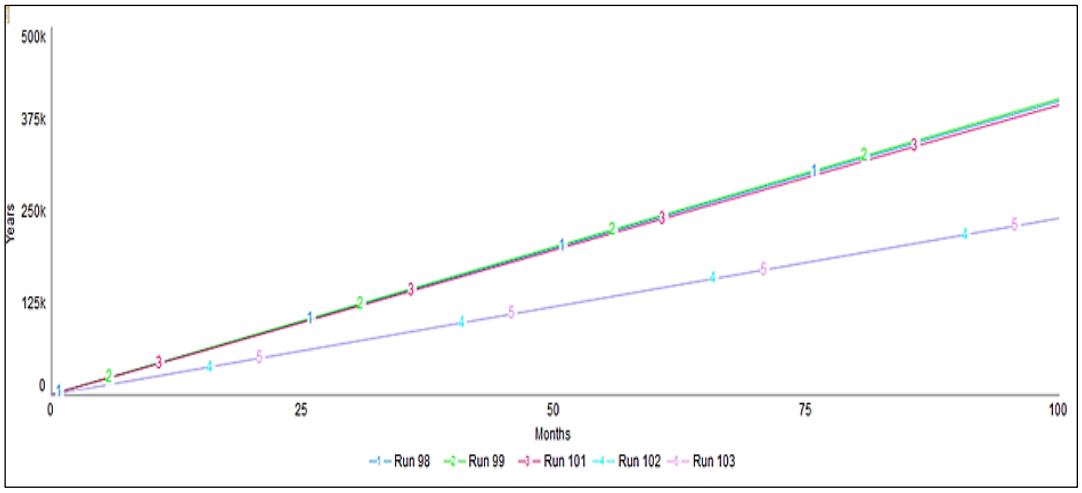

Figure 7: Sensitivity Run for Economic sustainability for Run 2

The positive trend observed in economic sustainability as the number of MFIs increases finds support in earlier studies. Research has shown that when microfinance institutions expand their reach and customer base, it tends to enhance their financial stability and long-term performance. For instance, expanding outreach allows MFIs to achieve greater scale and operational efficiency (23). Similarly, profitability, loan portfolio growth, and service coverage as critical to sustaining institutional performance (43). These patterns are further reflected in NABARD's recent reports (39), which note that broader access to credit through MFIs has played a key role in improving employment outcomes and entrepreneurial activity, particularly in rural areas.

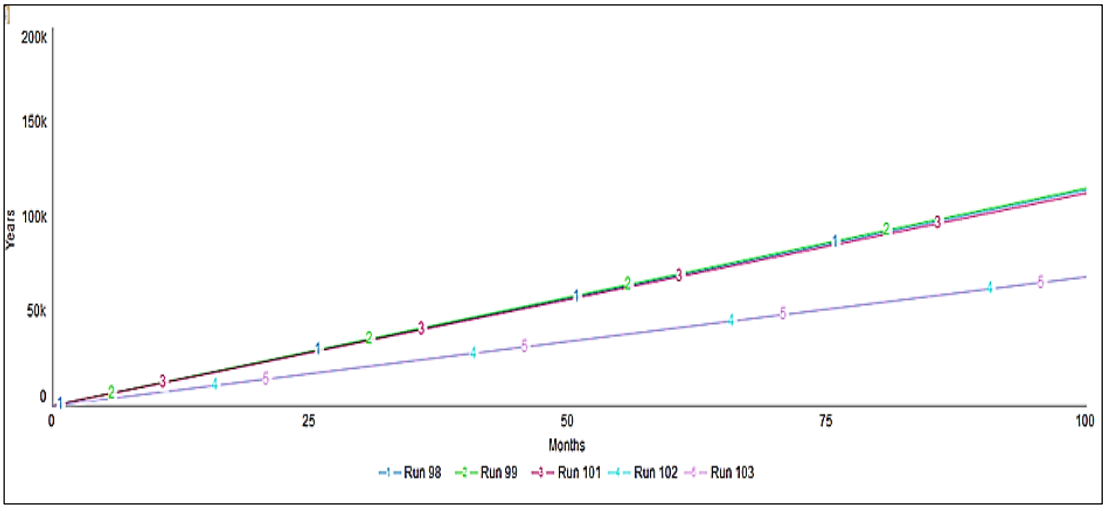

Figure 8: Sensitivity Run for Social sustainability for Run 2

The above shown figures represent the graphs of how within simulation run the Number of Microfinance Institutions in India (Figure 7), Economic Sustainability (Figure 8) and Social Sustainability (Figure 9) are impacted. The Number of Microfinance Institutions in India graph tends to increase the angle of linearity as the parameter was doubled. The rest two, Economic Sustainability and Social Sustainability tends to have very slight impact. Now, keeping the Number of Microfinance Institutions constant, the Percentage of Female borrowers is increased to double, to check its impact on overall sustainability and to that on economic and social sustainability.

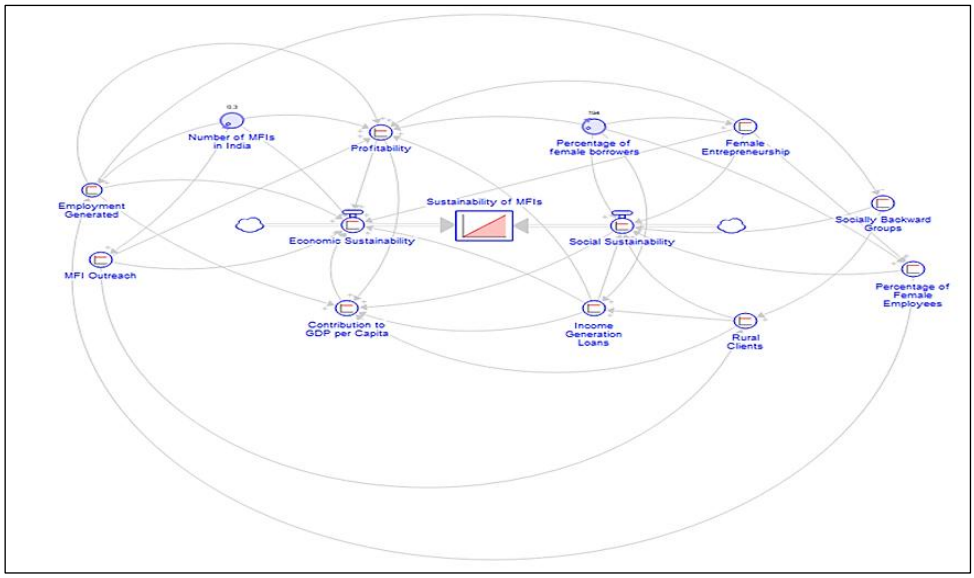

Figure 9: SFD for Sensitivity Run for Run 3

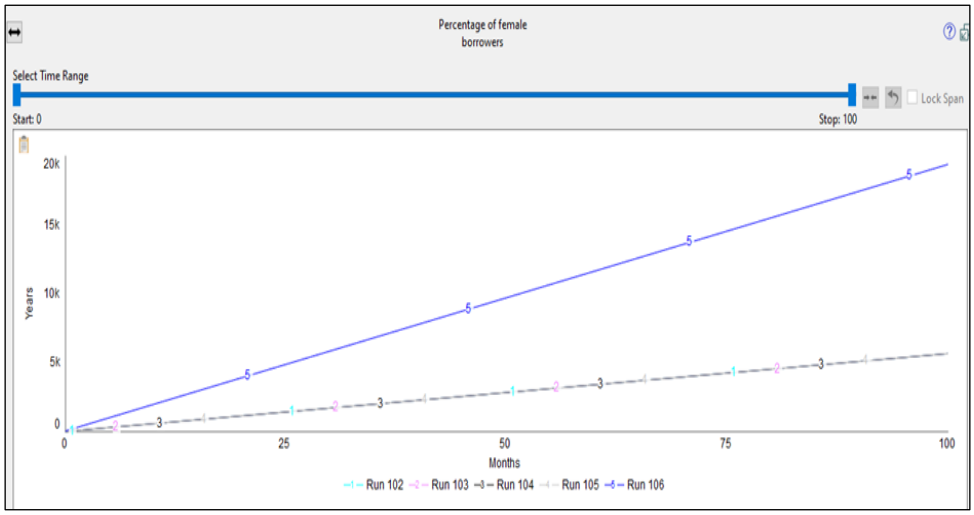

Figure 10: Sensitivity Run for Percentage of Female Borrowers for Run 3

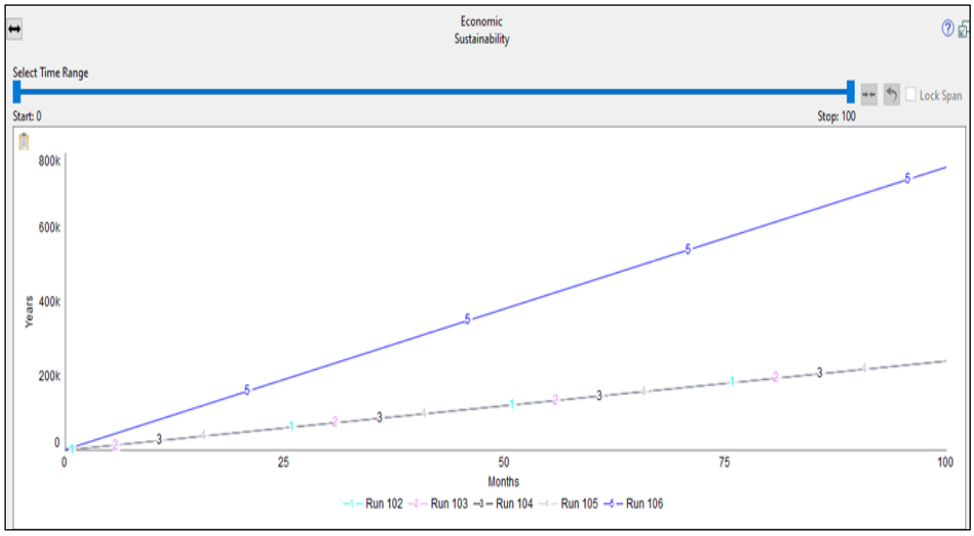

Figure 11: Sensitivity Run for Social Sustainability for Run 3

In the next set of outputs, Figure 10 shows the simulation for a rise in the Percentage of Female Borrowers (PFB), and its effect is clearly captured in Figure 11, where the social sustainability curve strengthens. This validates the model's representation of female borrower inclusion as a key contributor to social development and empowerment. The trajectory reflects enhanced financial inclusion, particularly among women (40-42). The simulation confirms that empowering women through targeted lending improves the social performance of MFIs over time. The model also highlights the role of women's participation and rural inclusion in strengthening social sustainability. This aligns with earlier research suggesting that when MFIs focus on gender-inclusive lending, they not only improve social outcomes but also build stronger client relationships and repayment culture. For example, MFIs with a higher percentage of female borrowers experienced better institutional performance and deeper community engagement (42). The findings also reflect that socially oriented MFIs, particularly those serving marginalized or remote communities, contribute meaningfully to equitable development (12). Likewise reports highlighted the importance of extending credit access to women and rural clients as a pathway to achieving long-term social impact (30).

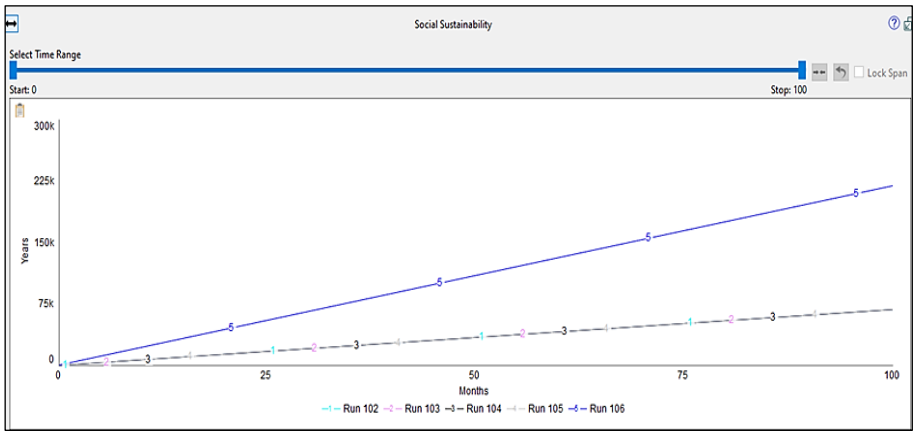

Figure 12: Sensitivity Run for Economic Sustainability for Run 3

The above figures show the sensitivity run for Run 3 where the Percentage of Female Borrowers is doubled and the results show that the change in percentage of female borrowers does not much impact the economic sustainability and social sustainability almost equally as the linearity within the graphs increase. Though Figure 12 shows a subtler change in economic sustainability resulting from increased female borrower participation, the trend still supports the idea that empowering women can generate indirect economic benefits. Women borrowers, often managing household-based enterprises, contribute to repayment reliability and productive loan use, which eventually feed into profitability and institutional stability reinforcing the social and economic linkages within MFI operations.

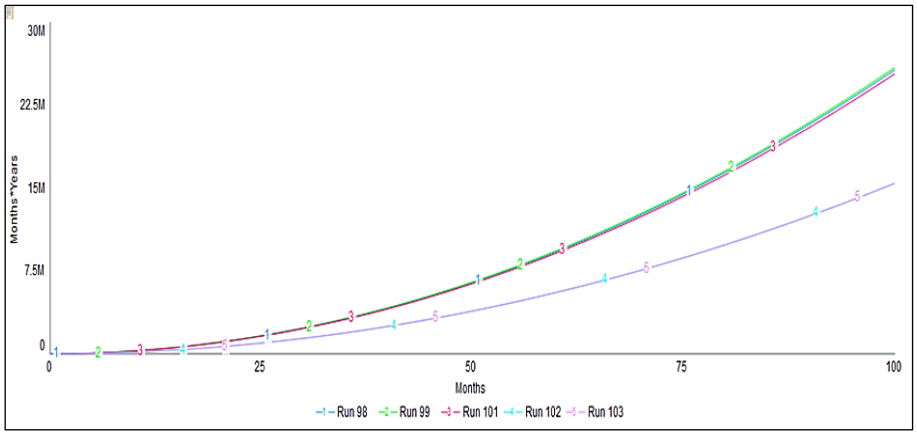

Figure 13: Sensitivity Run for Sustainability of Microfinance Institutions for Run 2 and Run3

The combined sustainability output shown in Figure 13 brings together the effects of both simulation runs, one focused on NMFI and the other on PFB. The model illustrates how changes in economic and social indicators influence overall sustainability (SMFI) when tracked together. The upward curve confirms that both types of input variables play a reinforcing role, and their compounded effect improves long-term institutional viability. This consolidated view highlights the alignment between model logic and real-world performance expectations, bridging system behaviour with measurable socio-economic outcomes.

The above shown Figure 13 shows that the sensitivity run for Run 2 and Run 3 consolidated for Sustainability of Microfinance Institutions which shows that on changing the parametric values of Number of Microfinance Institutions in India (NMFI) and Percentage of Female Borrowers (PFB) parameters, the overall sustainability of Microfinance Institutions (SMFI) within sensitivity run tends to exponentially and gradually increase as shown. It is because of the reason that besides NMFI and PFB share linear relationship with SMFI, since they are delayed converters and tends to increase gradually, it leads to enhancing the sustainability of Microfinance Institutions at slower pace.

The combined sustainability output from the simulation reinforces the idea that economic and social dimensions must work together to ensure the long-term success of MFIs. Rather than treating these aspects in isolation, recent frameworks suggest that institutions thrive when they balance financial strength with inclusive service delivery. This is in line with the integrated approach which views social and financial sustainability as mutually reinforcing (14). Additionally, it is argued that MFIs rooted in inclusive ecosystems with strong outreach, localized operations, and gender diversity are better equipped to handle structural challenges and maintain long-term impact (6). The model's outcomes clearly illustrate how this dual focus on growth and inclusion strengthens overall sustainability.

The system dynamics simulation results presented in this study are closely supported by empirical trends observed across India's microfinance landscape. For instance, the model shows that an increase in the number of MFIs leads to greater economic sustainability over time, which highlight that expanded institutional presence has facilitated employment growth and credit access in rural areas (39). Similarly, the positive influence of female borrower participation on social sustainability aligns with insights that how inclusive lending practices have improved women's financial independence and strengthened community-level development (30).

Field-level studies also suggest that MFIs focusing on gender-oriented lending often report better loan recovery rates and client retention (34). Moreover, empirical research suggests that the dual pursuit of financial and social goals in microfinance institutions not only enhances outreach but also improves long-term viability (12). By integrating such realworld observations, the model's simulated outcomes are shown to reflect and reinforce the actual performance behaviour of MFIs in diverse Indian settings.

Discussion

The results of this study offer meaningful insights into how Microfinance Institutions (MFIs) can balance financial strength with social responsibility to ensure long-term sustainability. The model highlights that economic factors such as institutional presence, employment generation, and profitability play a significant role in maintaining financial health. At the same time, social aspects particularly women's participation, support for marginalized communities, and rural outreach emerge as equally important in shaping the inclusive impact of MFIs. These findings reinforce the idea that sustainability in microfinance is not just about profitability or portfolio performance, but also about the depth and inclusiveness of outreach. When MFIs integrate both economic and social goals, their operations tend to be more resilient and impactful over time. The model's outputs support this dual-focus approach and align with broader development goals related to financial inclusion, gender equity, and rural empowerment (4, 5).

While this study uses national-level data to construct the model, it is important to recognize that local economic and social conditions can significantly influence how microfinance systems behave. Differences in regional income, employment opportunities, social norms, and financial literacy levels may affect how variables

within the model respond over time. For example, MFIs operating in low-employment areas may show quicker impacts on income generation (5), whereas regions with traditionally low female financial participation may see slower social progress (31). Although the current model does not explicitly incorporate these regional variations, it provides a flexible foundation that could be adapted using local data in future studies to produce more targeted and context-aware insights. This study was developed using secondary data and insights from existing literature, without direct engagement from field-level stakeholders such as MFI staff, borrowers, or regulatory authorities. While the model's structure was grounded in empirical evidence and validated against historical trends from institutions like RBI and NABARD (41, 42), the inclusion of stakeholder perspectives could have further strengthened its practical relevance. Future research could explore participatory modelling approaches involving expert consultations, field insights, and policy dialogues to enhance the model's accuracy, adaptability, and alignment with on-the-ground realities.

This study used scenario-based simulations to examine how specific policy actions could impact the sustainability of Microfinance Institutions (MFIs) in India. The first scenario modelled government efforts to expand MFI presence in underserved rural and semi-urban areas through incentives and partnerships, which showed a steady increase in economic sustainability by improving job creation, profitability, and outreach. The second scenario explored enhancing gender-inclusive lending by increasing female borrowers, leading to notable gains in social sustainability and modest improvements in economic performance. These findings suggest that policies promoting wider access and gender-responsive financial services can strengthen both social and economic aspects of MFI sustainability (44). Future research could extend these simulations by incorporating factors like digital finance, credit reforms, or interest rate changes to better understand how targeted interventions influence MFI success. The findings suggest several practical directions for strengthening the sustainability of MFIs. Promoting gender-focused lending initiatives can help improve women's access to credit and enterprise development, which in turn enhances both social outcomes and financial performance. Expanding MFI operations in underserved and rural regions should also be prioritized, as these areas often lack sufficient financial access. Additionally, integrating system dynamics tools into policy planning could support more informed decision-making by allowing stakeholders to simulate the long-term effects of proposed interventions before implementation (39).

Conclusion

Microfinance Institutions play a key role in promoting financial inclusion by providing credit to underserved communities, yet many still remain beyond their reach due to limited awareness and coverage. This study underscores that the long-term sustainability of MFIs depends on their ability to balance financial performance with meaningful social outreach, particularly toward marginalized groups such as women. Expanding into underserved areas, adopting risk-reducing models like group lending, and aligning with sound regulatory practices are crucial steps forward. Future research can build on this framework by incorporating local data, involving stakeholders in refining the model, and exploring innovative policy tools such as digital finance and green lending to better support inclusive and resilient microfinance systems.

Abbreviations

CGDP: Contribution to GDP Per Capita, CLD: Causal Loop Diagram, EG: Employment Generated, ES: Economic Sustainability, FE: Female Entrepreneurship, IGL: Income Generation Loans, MFIO: MFI Outreach, MFIs: Microfinance Institutions, NMFI: Number of MFIs in India, PFB: Percentage of Female Borrowers, PFE: Percentage of Female Employees, Pr: Profitability, SBG: Socially Backward Groups, SFD: Stock Flow Diagram, SMFI: Sustainability of MFIs, SS- Social Sustainability, RC: Rural Clients.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Author Contributions

Each of the mentioned authors has approved the work and contributed significantly, directly, and intellectually.

Ethics Approval

Not applicable.

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