

# Prediction of Factors Influencing Social Performance of Indian MFIs using Machine Learning Approach

Ranjeeta Nayak<sup>1</sup>, Prof. (Dr.) Sasmita Samanta<sup>2</sup>

<sup>1</sup>(Ph.D Scholar, School of Humanities and Commerce, KIIT Deemed to be University, Bhubaneswar, 751024, India, Email: ranjeetanayak25@gmail.com)

<sup>2</sup>(Professor, School of Humanities and Commerce, KIIT Deemed to be University, Bhubaneswar, 751024, India, Email: drsasmita@kiit.ac.in)

## Abstract

The aim of the current work is to predict the impact of MFI specific internal factors on the social performance of Indian microfinance institutions (MFIs) by using machine learning techniques. Social performance index (SPI) is designed by taking data of 73 Indian MFIs for 10 years with the help of an indexing technique where six different factors (operational self sufficiency, number of women borrowers, number of rural borrowers, gross loan portfolio, average loan balance per borrower / GNI per capita and cost per borrower) representing different dimensions of functioning of MFIs are considered. The data is taken from MIX data repository. Pooled OLS regression model is used for analyzing impact of various MFI specific factors on SPI. For predicting the SPI, Artificial Neural Networks (ANN) machine learning model is considered that takes all independent variables as input. The results of regression model indicate that size, legal status, outreach and service provisions significantly affect SPI. ANN analysis result indicates that social performance of MFIs gets determined by MFI specific internal factors. The experimental result indicates that the proposed ANN prediction model is providing better result for predicting the SPI. The findings suggest that MFIs can contribute for development of the society by adopting suitable policies keeping in view certain internal factors.

**Keywords:** Social performance index (SPI), microfinance institutions (MFIs), Social performance management, Artificial Neural Networks (ANN), machine learning model, Prediction.

## I. INTRODUCTION

The growing trend of microfinance industry at global, national as well regional level indicates the significance of microfinance services not only for socioeconomic growth of poor but also for economic development of nation. As social entities, MFIs<sup>1</sup> always work for achieving a social mission which can be poverty eradication, women empowerment, educating people, financial empowerment etc. MFIs specifically target low income people to provide them verities of financial products and services with the intention of enabling them to establish their own ventures. These organizations not only aim at financial empowerment of poor but also try for improvement of standard of living.

With this noble objective of serving the society, MFIs always need to design efficient techniques for managing their social performance. Social performance of MFIs means extent to which and efficiency with which, MFIs are capable of achieving their mission. It is challenging for these institutions to enhance their social impact (Lyon and Fernandez, 2012; Snigdha, Sasmita and Arpita, 2020). MFIs need to efficiently convert their inputs into outputs in order to create significant social influence. Proper resources management is very crucial for this reason.

Social performance improves client participation, mutual trust and satisfaction. This results into higher repayment rate and lower transaction cost ensuring financial sustainability of MFIs in long-term.

In case of emerging economy like India, there is even more important role played by social institutions like MFIs. Social development contributes towards economic development of the nation. MFIs can play crucial role in eradicating poverty, which will be helpful for social development. Absence of access to financial facility is the main cause for the poor being in poverty (Narwal and Yadav, 2014; Samanta and Nanda, 2019). Because poor may not be able to develop capacity to repay the loan, many financial institutions in formal financial system hesitate to provide credit facility to poor. Microfinance is an effective tool in resolving the problem as MFIs target poor people and provide different financial, non-financial products and services, such as- loans, deposit facility, insurance, consultancy service, training services, capacity building facility etc. MFIs in India need to focus on social performance improvement for contributing more towards economic development of the country.

Considering the importance of social performance improvement of MFIs, this study aims at analysing factors affecting social performance of Indian MFIs. Various MFI specific internal factors, including- age,

<sup>1</sup> MFIs is the abbreviation used for Microfinance Institutions

legal status, size, outreach, service provision can affect social performance of MFIs. This is important to analyse each of these factors and their influence on social performance. The study contributes to the existing literature by designing a social performance index to quantify the quality of social performance and explaining the importance of several factors in improving social performance standard of Indian MFIs. The study uses ANN analysis for predicting social performance scores of MFIs by using different MFI specific internal factors. The results of the regression analysis regarding individual impact of each of the internal factors can help MFIs to understand and improve different internal aspects for achieving the targeted social performance goal. Various policies can be designed considering the empirical findings of the study for strengthening the social performance of the MFIs.

The rest of the article is organized as follows-The next section presents evidence of existing literature along with hypotheses of the study. Section 3 describes data and variables. In Section 4, a discussion is made on research methodology. Section 5 contains results and discussion. Last section i.e. Section 6 provides implications of the study, suggestions for MFIs and conclusion of the study.

## II. REVIEW OF LITERATURE

As social entities, MFIs always need to focus on their social performance. The degree of impact these institutions can create, determines their level of social performance. Various aspects of social performance have been focused in literature. One such aspect is efficiency analysis of MFIs i.e. efficiency with which MFIs are able to generate outputs. Efficiency can be measured by the costs which are spent by MFIs for providing various financial products and services to clients. Many studies have used Data Envelopment Analysis (DEA) to measure this efficiency. Under DEA technique efficiency of a particular MFI in comparison with the best practicing MFI is determined through frontier analysis. This frontier is a line showing combinations of output and minimum input and efficient institutions are those which get located exactly on the frontier line. MFIs coming below the frontier are called inefficient. The distance between the area below frontier and frontier line indicates the extent of inefficiency. Mainly cost efficiency is focused in microfinance literature (Hermes et al., 2011). Cost efficiency means minimum cost with which MFIs can provide financial services to poor. As social enterprises aiming at serving the poor, MFIs cannot expect high return on their lending. So, cost efficiency is the only way for financial sustainability of these institutions.

Number of clients served, number of branches established, loan, savings accounts, total number of women borrowers are some of the major factors considered for analyzing efficiency of MFIs (Mia & Chandran, 2016, Wijesiri et al., 2015).

A separate wing of literature focuses upon identification of factors influencing social performance standard of MFIs. Social performance of MFIs is determined by both internal (MFI specific factors) and external factors (legal policies, regulatory requirements). Internal factors influencing performance include-age of MFIs, size, legal status etc. Age or maturity of MFIs means number of years for which MFIs have been operating. With more number of operating years more and more experience is acquired by these institutions. This experience can help MFIs for improving their business operations. With experience, they learn to minimize cost, provide innovative financial products and services, motivate clients to repay the loans taken, and train employees to handle clients efficiently etc. Experience helps MFIs to deal with poor clients more efficiently. Paxton (2007) proved that the technical efficiency earned by MFIs with the growing age helps them to reduce operating costs and provide different products and services to their clients at a lower price. With more years of services clients become more loyal towards MFIs; MFIs become more responsible towards clients (Rashid and Twaha, 2013). But at the same time a newly established MFI can provide innovative products and services for enhancing their social impact. This is also true that poor clients do not see reputation of MFIs before seeking loans (Narwal & Yadav, 2014). MFIs may tend to diversify their customer base especially to larger-size and male customers as they grow older (Wijesiri et al., 2015). So, mission drift can be one cause for matured MFIs not being socially efficient (Mersland & Strøm, 2010). After analyzing the literature carefully, we develop our first hypothesis as follows:

H1: Age has significant influence on social performance of MFIs.

Size of MFIs is another important factor which can influence their performance. Size means how large the MFI is in terms of their assets. If the MFI is large, it will have more financial resources to serve their clients in a better manner. Larger MFIs enjoy the benefit from economies of scale by replicating the provision for different financial products and services in different geographical areas and to different customer groups. Literature has also evidence that size can negatively impact social performance of MFIs. Engels (2009) by analyzing data of 600 MFIs concluded that size negatively affects social performance of MFIs. Mission drift can be one

possible cause of the same. As MFIs become large in size, they tend to diversify their operations to various ancillary businesses. This also involves risky business activities, which reduces their capacity to take additional risk of lending money to poor. Large MFIs ignore poor and women clients because they become established and created a social image. So, they try for more financial gain. The second hypothesis is defined as follows:

H2: Size significantly affects social performance of MFIs.

Legal status or natures of MFIs can have significant impact on the social performance of MFIs. Rules and regulations for regular operations of business are being dependent upon the fact whether a particular MFI is for-profit (NBFC, NBFC-MFI) or not-for-profit MFI (societies, trusts, local area banks, cooperatives). Not-for-profit MFIs normally perform more socially compared to their for-profit counterparts because serving the poor is their core objective. Several studies such as- Cull et al. (2009), D'Espallier et al. (2013), Gutiérrez-Nieto et al. (2009) have confirmed better social performance scores of not-for-profit MFIs compared to their for-profit counterparts. Barry & Tacneng (2014) analyzed data of various Sub-Saharan African countries and concluded that NGOs have better social performance. The reason can be that stringent regulations have negative influence on social performance of MFIs. Regulated MFIs need to follow the rules, regulations prescribed by the regulators. So, they need to maintain minimum net worth, net assets etc. as per the regulatory requirements. It becomes mandatory for them to maintain a standard financial performance. Mission drift is caused due to such mandatory requirement, which can be one cause of reduced social performance standard of regulated MFIs. But literature also has evidence regarding higher social performance record of for-profit MFIs in comparison to not-for-profit. Tchakoute-tchuigoua (2010) reported a higher social performance result of for-profit MFIs than not-for-profit MFIs. When MFIs are for-profit, they use to have better financial performance. The financial strength acquired by these MFIs helps them to perform their social responsibilities more efficiently. The third hypothesis is stated as-

H3: Legal status has significant impact on social performance of MFIs.

Outreach means the extent to which microfinance institutions are able to reach their expected clients with varieties of products and services at a reasonable cost for improving their standard of living. It can significantly influence the efficiency and performance of MFIs. There are basically two dimensions (breadth and depth) of outreach outreach (Navajas et al, 2000; Abdulai

and Tewari, 2017; Mohanty and Samanta, 2022). Under breadth strategy organizations try to enhance the number of clients served. More focus is given on widening the geographical area coverage, membership base, working budget etc. (Uvin, 1995). When MFIs serve more number of clients, they tend to gain the benefits of economies of scale due to multiple repetition of service provision. The analysis by Paxton (2007) using the data of 190 semiformal financial institutions concluded that rural outreach is positively associated with efficiency. The more an institution targets at rural people, the more it would try to reduce cost to achieve the targeted financial gain. But reaching out more number of poor people can create an adverse effect on financial position of social institutions as it is more unlikely that the poor will repay the loans in time. Hermes et al. (2011) found that outreach negatively affects efficiency. Under depth strategy institutions try to offer wide range of services to a small group of customers with the belief that social impact can be created through root out of basic social problems even if it is for a small range of people. Fourth hypothesis for the study is mentioned as the following:

H4: Outreach has significant impact on social performance of MFIs.

When MFIs provide different types of services, they serve the clients in a better manner. Enterprise financing can be a major way of providing financial services to micro and small industries. MFIs can establish more number of offices for providing various services to rural and poor people. It is a parameter to measure social performance of MFIs. Number of loans given by loan officers of MFIs indicates the quality of services provided by these institutions. So, it is crucial to analyze the impact of various service provisions on social performance of MFIs. In this context the study aims to test the following hypothesis-

H5: Service provision has significant impact on social performance of MFIs.

This study aims at analyzing impact of various institution specific factors on the social performance of MFIs. Though some of the research works have focused upon analyzing factors determining social performance of MFIs, there doesn't exist evidence of consideration of the unique set of institution specific independent variables which is taken for this study. Literature doesn't have evidence regarding social performance analysis of Indian MFIs. India is a developing country with a unique legal and political environment. MFIs play a significant role in the economic and social development of the nation. Social performance analysis of Indian MFIs can help these institutions for improving their social performance. This can

contribute a lot to the development of the country. The study is an addition to the existing literatures which focus on designing of social performance indices by following different indexing techniques. ANN analysis is done for predicting social performance of Indian MFIs by using different internal factors. To the best of authors' knowledge, there is no literature on microfinance social performance which uses ANN analysis. Some of the recent research works have focused on application of ANN model for risk assessment, management and loan portfolio management of microfinance (Zhong and Zhou, 2020; Condori-alejo et al. 2021; Hajji and Jamil, 2019). Yaroshchuk *et al.* (2019) used neural network method for improving the quality of lending by MFIs. Literature doesn't have evidence on use of ANN in the area of social performance analysis. Use of ANN as a predictive model for social performance analysis will be helpful for MFIs in management of different aspects of social performance improvement.

### III. DATA AND VARIABLES

The study uses secondary data of 73 Indian MFIs for 10 years i.e. 2010 to 2019. Out of total 234 MFIs operating in India, data for 73 MFIs is considered for analysis due to availability of information on dependent and independent variables for these MFIs only. The study is based on MIX market financial data collected from MIX market website. MIX market financial data set consists of data for 10 years i.e. from 2010 to 2019. Data collection and cleaning are done using Microsoft excel program. Data cleaning is based on the criteria of availability of both dependent and independent variables data. SPSS software is used for ANOVA (Analysis of Variance) analysis and Stata software is used for running regression model. Python is used for ANN (Artificial Neural Network) analysis.

#### 3.1. Variables

The study uses an indexing technique for measurement of social performance of Indian MFIs. So, the measured SPI (Social Performance Index) is used as the dependent variable for analysis. For generating the SPI, six indicators are used. Those indicators are operational self sufficiency (OSS), number of female borrowers (FB), number of rural borrowers (RB), gross loan portfolio (GLP), and average loan balance per borrower / GNI per capita (ALBGNI) and cost per borrower (CB).

##### *Operational Self Sufficiency (OSS)*

This indicates the ability of MFIs to meet their operational costs by using the income generated. This is a tool for measurement of efficiency of MFIs. When MFIs are efficient in managing their operational costs, they can

provide less costly services to their clients. So the more is the OSS, the better is social performance of MFIs.

$$OSS = \frac{\text{Operating Revenue}}{\text{Operating expense} + \text{Impairment expense} + \text{Financial expense}} \quad (1)$$

##### *Number of Female Borrowers (FB)*

When the topic is about social development, women are the most important segment which needs to be focused upon. Starting from financial independence to different business initiatives taken by women, everything is important for development of society. So, MFIs should focus upon lending more money to female borrowers in order to enable them for taking various business initiatives. When MFIs provide loans to more number of female borrowers, this indicates their strength of performing well socially. So, more number of female borrowers gets higher social performance rating.

##### *Number of Rural Borrowers (RB)*

Social and economical development of a nation can be achieved only with the development of rural areas. MFIs should focus upon providing financial assistance to rural people in order to foster social development. With increased number of rural borrowers, the social performance of MFIs also gets better and better.

##### *Gross Loan Portfolio (GLP)*

This is the total of all outstanding principal amounts due from clients. When MFIs provide more loans, the GLP becomes more. Provision of more amounts of loans to clients is the symbol of good social performance, as MFIs can create enhanced social impact by providing more loans to clients. So, more GLP indicates higher social performance index.

##### *Average Loan Balance per Borrower / GNI per capita (ALBGNI)*

This ratio indicates the size of loan given by MFIs as proportion of gross national income. A low ratio means MFIs give small amount of loan and they serve more number of clients, whereas a high ratio implies higher amount of loan to limited number of clients. A low ratio is considered as good compared to a high ratio in the perspective of social performance, because when MFIs serve more people, they serve the society in a better manner. At the same time when loans are given to different people, the chances of total default reduce. MFIs tend to become financially strong by following this method. Financial strength achieved helps MFIs to work for betterment of society. In this context a low ratio indicates better social performance.

$$ALBGNI =$$

*Average Loan Balance Outstanding of a particular borrower*

*GNI Per capita*

(2)

*Cost per Borrower (CB)*

This is the ratio of operating expenses to total number of active borrowers of MFIs. When cost per borrower is less, this indicates the efficiency of MFIs in providing less costly loans to borrowers. Through this MFIs do serve the society in a better manner. So, a lesser cost per borrower ratio gets better social rating.

$$CB = \frac{\text{Total Operating Expenses During a Period}}{\text{Total Number of Active Borrowers During the Same Period}}$$

(3)

As the study aims to find out MFI specific factors which affect their social performance, five factors have been considered as independent variables i.e. age, size, legal status, outreach of MFIs and service provision. The following table (table 1) contains details of variables and sources of data.

Table 1: Data & Variables

Variables	Description	Data source
Age	Maturity of MFIs since the year of inception	Sa-Dhan report <sup>2</sup>
Size	Ln of total assets	MIX market financial data set
Legal status	Dummy variable; 1 if not-for-profit and 0 if for-profit	Sa-Dhan report
Outreach	Number of clients served by MFIs	Sa-Dhan report
Service provision	Three factors (enterprise finance, number of offices and loans per loan officer) have been considered for calculating service provision index. The indexing methodology considers formula A mentioned below (under methodology section) i.e. a higher value gets more rating. Sum of all three	Data on enterprise finance, number of offices and loans per loan officer are collected from MIX market financial data

<sup>2</sup> Sa-Dhan is a self-regulatory organization in microfinance sector which works for community development finance in India. The report published by this organization is Sa-Dhan report.

	indices indicates service provision index.	set
OSS	OSS means operating expenses divided by income earned. More OSS gets higher index. Formula A is used for OSS indexing.	MIX market financial data set
FB	FB means number of female borrowers. More FB gets higher index. Formula A is used for FB indexing.	MIX market financial data set
RB	RB means number of rural borrowers. More RB gets higher index. Formula A is used for RB indexing.	MIX market financial data set
GLP	GLP is the total of all outstanding principals due from clients. More GLP gets higher index. Formula A is used for GLP indexing.	MIX market financial data set
ALBGNI	ALBGNI is the size of loans given by MFIs as proportion of gross national income. Low ALBGNI gets higher index. Formula B (mentioned under methodology section) is used for ALBGNI indexing.	MIX market financial data set
CB	CB means operating expenses divided by total number of active borrowers. Low CB gets higher index. Formula B is used for CB indexing.	MIX market financial data set

(Source: Formulated using MS Word)

**IV. METHODOLOGY**

**4.1. Social Performance Index**

Social performance is a diversified concept including several aspects of operations of MFIs. A holistic approach considering all such aspects can be useful in measuring social performance of these institutions. This study develops one integrated model using different indicators of operational strategies adopted by MFIs. SPI is the representation of six different variables indicating different aspects of business operation. OSS indicates how efficiently MFIs are capable of managing their operational spending,

FB and RB indicates the outreach of MFIs to female and rural borrowers to improve their living standard, GLP is the total principal amount outstanding for MFIs symbolizing the financial support provided, ALBGNI and CB are the indicators of MFIs' internal financial strength gained by following different strategies i.e. providing small amount of loan to more clients and reducing operating expenses per borrower. These variables have two different impacts on SPI. For the first four variables (OSS, FB, RB and GLP); an increased ratio contributes to higher SPI and for last two variables (ALBGNI and CB); a low ratio means better social performance.

**4.2. Social Performance Indexing Technique**

The six indicators explained above are rescaled using a 10 to 100 scale and summed up for calculating SPI.

$$SPI = OSS + FB + RB + GLP + ALBGNI + CB \tag{4}$$

OSS, FB, RB, GLP, ALBGNI and CB are the rescaled values of the above mentioned indicators. Two separate formulas are used for rescaling the indicators. The following formula is used to rescale those indicators for which a high ratio means good social performance-

$$A = \beta + \left[ \frac{(b-\mu) \times (\alpha-\beta)}{(\omega-\mu)} \right] \tag{5}$$

Another formula is used for the indicators for which a small ratio means good social performance-

$$B = \alpha * \left( \frac{\omega-b}{\omega-\beta} \right) \tag{6}$$

$\alpha$  and  $\beta$  are the highest and lowest rescaled values i.e. 100 and 10.  $\omega$  and  $\mu$  are the highest and lowest recorded raw values of different indicators used in the analysis for calculating SPI.  $b$  is the specific indicator value of a given MFI for a particular year.

The conceptual framework of the study is presented in Fig. 1.

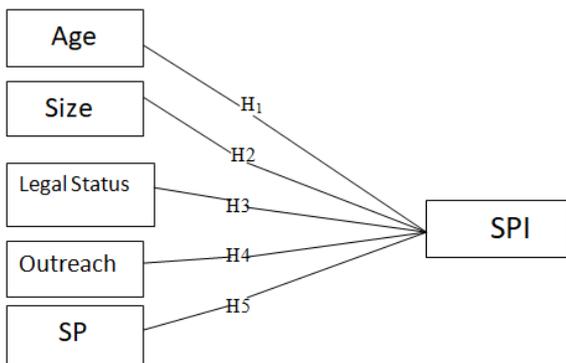


Figure 1: Conceptual framework of the study  
(Source: Presented using MS Word)

**4.3. Analytical Models**

Pooled OLS regression model is applied in this study to analyze the impact of different independent variables on the dependent variable (SPI) as the panel data set consists of data for 73 Indian MFIs for 10 years time period. Results of hausman test and Breusch-Pagan Lagrange multiplier (BPLM) test indicate that pooled OLS model is most appropriate for the present panel data set.

$$SPI = \alpha + \beta_1 age + \beta_2 size + \beta_3 legal\ status + \beta_4 outreach + \beta_5 service\ provision \tag{7}$$

Variance inflation factor (VIF) is calculated to check whether there is multicollinearity problem in the data set. The results indicate that there doesn't exist multicollinearity problem.

The study conducts ANOVA analysis to determine whether the model is a significant predictor of dependent variable or not. ANN model is used in this analysis to predict SPI index by using all independent variables.

**ANN Prediction Model**

Neural network is the highest favored machine learning model which works as per the principle of biological nervous system. Artificial neurons which work in a layered structure are the basic constituents of a neural network. Input data passes through the hidden layer after it is captured in the input layer. The final output is given by the output layer after processing in the hidden layer. There is a forward direction flow of data in case of feed forward neural network i.e. data goes from input layer to output layer. This predicting model is applicable for both linear and non-linear classification problem with differences in structure as well as learning algorithms. The proposed model is working on the principle of feed forward neural network. The independent variables are considered as the input to the neural network model and backpropagation learning algorithm is considered for training the model. The predictive model has four layers such as-one input layer, two hidden layers, and one output layer. The node size in input layer is five that contains the independent inputs for predicting the SPI Index. The input data is passed through the hidden layer with some weight value. At each layer the incoming data is passed through the activation functions for obtaining the actual output. Here two different types of activation functions such as Softmax and rectified linear unit (Relu) are used in hidden and output layer respectively. The network is learned with the training data with backpropagation learning algorithm. The output of the each layer  $y$  can be represented by

$$y = w.x + b \tag{8}$$

Where  $w$  is the weight,  $x$  is the input data, and  $b$  is the bias. Again this output is passed through the activation function for obtaining the nonlinear output and the final output  $y'$  can be represented by

$$y' = \sigma(y) \tag{9}$$

Where  $\sigma$  is the activation function. Here we have used the softmax activation function which is a normalized exponential function. Literature has evidence regarding well acceptance of this function. This function considers exponential values of the input signal. The output function evaluates the ratio of the exponential to sum of exponentials. The probabilities of output data is the benefit of this function. The probabilities differ in between 0 and 1. Every class probability is given by softmax activation function and the final output gets highest probability in case of multiclass classification problem.

This function can be represented by:

$$s_j = \frac{e^{x_j}}{\sum_{i=1}^n e^{x_n}} \tag{10}$$

Where,  $x$  indicates the value of input and  $s$  the value of output. These values are between 0 and 1 and their sum equals to 1.

Relu is the mostly used activation function which is used in the output layer of the network. The most important benefit of using this function is that all the neurons don't get activated simultaneously as it converts all the negative neurons into zero. This activation function also provides faster training compared to other functions. Mathematical representation of it is

$$f(x) = \max(0, x) \tag{11}$$

Where  $x$  is the input data and  $f(x)$  is the output function that returns the maximum value between 0 and input data. Around 80% data (584 data points) is considered for training the ANN model and rest 20% (146 data points) is taken for testing the trained model.

The structure of ANN is presented in Fig.2.

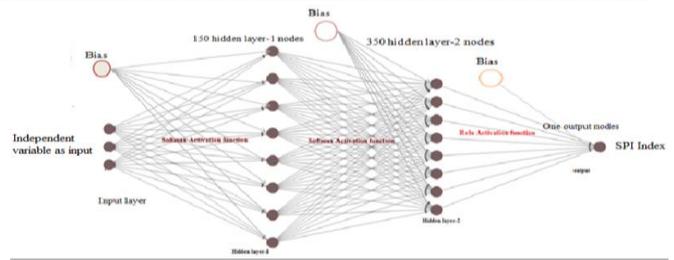


Figure 2: Structure of ANN

(Source: Python result)

The performance of the model is measured through coefficient of determination ( $R^2$ ), root mean squared error (RMSE) and absolute average deviation (AAD). Following formulas were used for getting the estimates of these statistical tools.

$$R^2 = 1 - \frac{\sum_{i=1}^n (Y_{\text{Predicted}} - Y_{\text{Experimental}})^2}{\sum_{i=1}^n (Y_m - Y_{\text{Experimental}})^2} \tag{12}$$

$$RMSE = \left\{ \frac{1}{n} \sum_{i=1}^n (Y_{\text{Predicted}} - Y_{\text{Experimental}})^2 \right\}^{1/2} \tag{13}$$

$$AAD = \left( \frac{1}{n} \sum_{i=1}^n \left| \frac{Y_{\text{Predicted}} - Y_{\text{Experimental}}}{Y_{\text{Experimental}}} \right| \right) * 100 \tag{14}$$

Where,  $y_{\text{predicted}}$  is the ANN provided predicted data,  $y_{\text{experimental}}$  is the experimental data,  $Y_m$  is the average and  $n$  is the number of experimental runs.

## V. RESULTS AND DISCUSSION

Table 2 gives summary statistics of all variables. The average social performance index of MFIs is 330.879 out of maximum 600 score. This indicates that most MFIs are above the standard because most MFIs have scored more than 50 percentage of total scoring. Minimum SPI is 176.798 compared to maximum 592.601. The high standard deviation of 40.471 indicates a huge scoring gap between Indian MFIs. Some of MFIs are focusing more on social performance improvement while some others need to put even more effort for improving SPI. Average size of Indian MFIs is 20.581.

Table 2: Descriptive Statistics

Variables	Mean	Std. Dev.	Min Value	Max Value
SPI	330.879	40.471	176.798	592.601
Size	20.581	2.224	14.804	27.053
Outreach	4.986	10.633	0.01	61.88
Service provision	58.368	30.555	30	207.676

(Source: Stata result)

Stated the minimum and maximum values of size, the average size is good. The standard deviation of 2.224 indicates that most of the Indian MFIs are of equal size during the taken study period. Minimum and maximum values of outreach indicates that some of Indian MFIs follow scaling wide (breadth) strategy whereas some others

follow scaling deep (depth) strategy. Scaling strategy means the technique followed by MFIs for serving the society, which is the basic objective of MFIs. Some MFIs believe in serving more number of clients to root out social problems. They are known as following scaling wide strategy. Some other MFIs do follow scaling deep strategy and focus upon limited number of clients to provide them all facilities. There is a difference in scaling wide and scaling deep strategy and the standard deviation of 10 lakhs outreach shows a huge difference in scaling strategies followed by Indian MFIs. Service provision by Indian MFIs in terms of enterprise financing, loans by loan officers and number of offices is 58 in average compared to maximum 207. This indicates that most of the Indian MFIs still need to improve their service provision in terms of the above mentioned three factors.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	466183.635	5	93236.727	92.747	.000 <sup>b</sup>
	Residual	727826.325	724	1005.285		
	Total	1194009.960	729			

(Source: SPSS result)

The result of ANOVA (table 3) indicates that the model is a significant predictor of dependent variable.

In the present study, an Artificial Neural Network (ANN) model is designed for predicting the SPI Index by analyzing various independent variables.

After successful training, the model is tested with the testing set data. The comparison of the actual and predicted SPI index value is presented in Fig.3 and it is observed that the proposed neural network model is providing better result in prediction. The error plot is shown in Fig.4. The parameters used for measuring the performance of the ANN model are shown in Table 4. The ANN result indicates that the dependent variable gets predicted by the independent variables considered in this study.

Table 4: Performance measuring parameters of ANN Model

Performance parameters	measuring Value
RMSE	0.0301
R <sup>2</sup>	0.991
AAD	0.012

(Source: Python result)

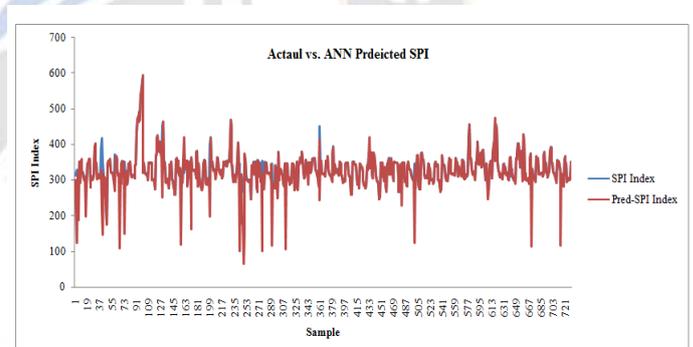


Figure 3: Actual Vs. ANN Predicted SPI  
(Source: Python result)

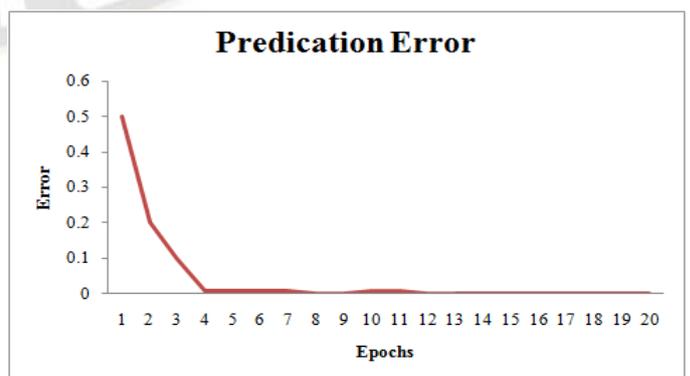


Figure 4: Error in ANN Prediction  
(Source: Python result)

Table 5: Regression Estimates

Dependent Variable Model	SPI Pooled OLS
Independent Variables	Coefficients
Age	-0.021 (0.941)
Size	3.069*** (0.000)
Legal Status	10.966*** (0.005)
Outreach	0.941*** (0.000)
SP	0.406*** (0.000)
Observations	730

(Source: Stata result)

P values in parentheses

Significance at 1%, 5% and 10% levels are indicated by \*\*\*, \*\* and \* respectively

The results of five hypotheses tests regarding impact of individual independent variables on dependent variable are presented in the (table 5). These results indicate that size of MFIs positively affect SPI. It has significant positive impact at 1% significance level. This means large sized MFIs have better SPI score. When MFIs become large in terms of total asset, they gain additional capacity to serve the society in a better manner. They can focus more on rural and female borrowers; their operational self sufficiency improves because the additional resources help them to meet their operating costs. The gross loan portfolio also becomes higher as they tend to afford providing more loans to clients (Kar, 2013; Nanda and Samanta, 2018). As per the result of the analysis, with 1 increase in value of size (Inasset), SPI score increases by 3.069. Legal status of MFIs also has positive significant impact on SPI at 1% significance level. In the present study as legal status is taken as a dummy variable, the result indicates that a not-for-profit MFI will have higher SPI in comparison to its for-profit counterpart as a not-for-profit MFI scores around 11 point more in SPI. When MFIs work for-profit, they normally ignore their social objective. More focus is given to strengthening the financial position than serving the poor. Whereas, not-for-profit institutions do perform better in social dimension because social objective is at the core of their functioning (Morduch, 1999). Another analysis by Gutiérrez-Nieto et al. (2009) also has found similar result that NGO-MFIs have higher social efficiency compared to for-profit MFIs.

Another independent variable outreach also has significant positive impact on SPI. When outreach of MFIs increases by 1 lakh, SPI increases by 0.941. Increases in outreach means, MFIs serving more number of people. This indicates scaling wide or breadth strategy. This is a strategy in which organizations give more importance to widen their geographical area coverage, membership base, number of clients, working budget, etc. (Uvin, 1995; Rup, Gochhayat and Samanta, 2018). It is based upon the concept of economies of scale as the production cost gets reduced with the provision of products and services to more and more people. As per the finding of the current study, increased outreach resulting from adoption of scaling wide strategy has positive influence on social performance scoring of MFIs. The independent variable service provision has significant positive impact on the dependent variable at 1% significance level. When service provision by MFIs increases by 1 point, SPI also increases by 0.406. MFIs providing more services to clients through enterprise financing, more number of offices, more loans stand ahead in social performance rating.

## VI. IMPLICATIONS AND SUGGESTIONS

The present study finds out social performance scoring for Indian MFIs by following an indexing technique. The main purpose is to analyze the factors affecting social performance of MFIs. The study considers MFI specific factors and their impact on social performance scoring. The results of the study indicate that various MFI specific factors significantly affect their social performance. As social entities, the basic objective of MFIs is to serve society. So, it is very crucial for these institutions to focus upon social performance because without this MFIs cannot sustain (Desa and Koch, 2014). The study creates implications both for the society and MFIs through its empirical analysis and findings. The study can be considered by Indian MFIs to design various policies for improving their social performance score and when the social performance of MFIs becomes strengthened, society gets benefited. When MFIs have higher social performance score, they can attract more amounts of donations, more government support, enhanced client response etc. Possession of more assets helps MFIs to spend more for social objectives. Resources strength helps MFIs to score more on social index (Marr and Churchill, 2012). MFIs should employ efficient staffs to properly handle the assets. Proper asset management can help MFIs to improve their SPI. Legal status of MFIs is also a very important factor, which can significantly affect their functioning. When MFIs are converting themselves into for-profit NBFCs to achieve financial sustainability, it is very important for these institutions to simultaneously focus on

their social objectives. Not-for-profit legal status has a positive influence on social performance score. Other studies by Gohar and Batool (2015) and (Mersland and Strøm, 2009) also show similar findings. Financially sustainable for-profit MFIs can keep the social objectives at the core of their business functioning and utilize the financial resources gained in order to achieve high level of social performance score. When proper finance management strategies are developed, for-profit MFIs can have equal level of social performance score similar to not-for-profit MFIs.

MFIs following scaling wide strategy and serving more number of people can score higher social performance. MFIs can design suitable policies for taking advantage of economies of scale in providing similar products and services to more number of people. Cost can be saved through replication of similar products and services (Kogut, 1985). Strategies such as-group lending scheme can be adopted to avoid failure of repayment of loans by clients. Along with provision of different financial products to clients, MFIs should also provide non-financial services such as- training to their clients to guide them in proper utilization of loans. More level of service provision through enterprise financing, loans to clients and establishment of more offices can help MFIs to better perform socially. MFIs can target more to extend financial assistance to small and medium enterprises to help them grow. Proper analysis before extending loans to enterprises, training to young entrepreneurs for proper utilization of loans taken can help in avoiding failure of repayment. Women entrepreneurship can be encouraged through provision of financial assistance. Rural area enterprise financing can help in community development. More number of loans by these institutions can help their clients for resolving various problems related to education, health, employment etc. Under group lending scheme a particular amount of loan can be given to several clients together to reduce the problem of moral hazard without receiving any collateral. It helps the clients in building mutual relationship to help each other in solving various problems and to repay the loan on time. When burden of collateral payment is not there, clients get motivated to work hard for achieving the objective for which loan is taken. More number of offices can be established especially in undeveloped areas to provide easy assistance to clients. Not only establishment of offices but recruitment of efficient office staffs, proper maintenance and record keeping of official data are also important for providing good quality services to clients. Overall MFIs can take care of each and every aspects of their functioning for accomplishment of their objective. Different strategies can

be designed by MFIs considering specific features, such as- size, legal status etc. for improving their social performance.

## VII. CONCLUSION

As social entities, this is the primary duty of MFIs to work for betterment of the society. Social performance management should be the top most priority of MFIs. It is important for these institutions to know their social performance scores and find out factors which influence these scores. The current study is focused in this direction as the study analyzes different factors influencing social performance scoring. The analysis of social performance of Indian MFIs highlights various aspects to be taken care for better social performance management. As Indian MFIs play a crucial role in social and economic development of the nation, the study can be taken as a guide in understanding various factors affecting social performance score. Several policies can be designed considering MFI specific factors, such as: size, legal status, and outreach among others to take these results for the advantage of the institution. With proper understanding of these factors, MFIs can improve not only their social performance but also they can strengthen their financial position. Some suggestions are given in this paper for better social performance management by MFIs. They need to learn the skill of designing and implementing various strategies to improve social performance score. In the aforementioned direction, MFIs can contribute a lot towards social as well as economic development of India.

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