European Economic Letters
ISSN 2323-5233
Vol 13, Issue 5 (2023)
http://eelet.org.uk

Ranking of Attributes for Commercial Banks Using Multi Criteria Decision Making

[1]Sarita Kumari Singh, [2]Jayanta Kumar Parida, [3]Prasant Kumar Pattnaik
[1]Research Scholar (Commerce), School of Social, Financial, and Human Sciences,
KIIT Deemed to be University, Bhubaneswar – 24, Odisha, India
Email: sarita.singh001995@gmail.com
[2]Director, School of Social, Financial, and Human Sciences,
KIIT Deemed to be University, Bhubaneswar – 24, Odisha, India
Email: jayantakp123@gmail.com
[3]Professor, School of Computer Engineering,
KIIT Deemed to be University, Bhubaneswar – 24, Odisha, India
Email: patnaikprasant@gmail.com

Abstract

The North Eastern Region of India, primarily mountainous and covered with deep forest, is lagging in financial integration due to the low potential of bank credit. In this region, there are a minimal number of commercial banks relative to other parts of India. Therefore, the significance of Regional Rural Banks (RRBs) increases. Thus, it becomes essential to evaluate the performance of these RRBs. This paper focuses on the AHP-MCDM methodology for the empirical ranking using the factors, i.e., finance, non-finance & customers that influence the demand for credit as well. This work focuses on ranking 5 North Eastern Regional Rural Banks using the MCDM- AHP method.

Keywords— North East, Regional Rural Banks, MCDM-AHP, Ranking, Finance, Non-Finance

1. Introduction

Regional Rural Banks (RRBs) are essential in developing a resilient and robust economy. RRBs are a crucial source of rural finance; supplying borrowers with the various forms of credit they require (Sabitha *et al.*, 2014). Moreover, stability in the banking system and the long-term performance of RRBs provide effective utilization of financial resources and appropriate financial flow throughout the economy's components (Bhagwat *et al.*, 2022).

Furthermore, it is essential for the sustained development of an economy that both urban and rural populations experience inclusive growth. However, financial exclusion continues to be a big problem in India. According to Findex 2021, about 22 percent of the population still needs a formal bank account (Chatterjee *et al.*, 2022). A notable disparity also emerges between rural and urban populations within different geographic regions (Boro, 2015). This is evidenced by the fact that the North Eastern States of India have a more significant average population per bank branch than India's average. Despite that, the Credit-Deposit (C-D) ratio in the North Eastern states is significantly lower than the national average (Raj & Das, 2019). Given that the North-Eastern states of India have a native population and abundant natural resources, it is crucial to examine the performance of the RRBs using current and precise methods to rank them within the banking system and enhance their performance.

Using Multi-Criteria Decision Making (MCDM) method, the present study attempts to assess the financial performance of North Eastern RRBs from 2019 to 2022. Analytical Hierarchy Process (AHP) (Saaty, 1988) is used to give relative weights to the criteria and analyze it to determine the preference order of attribute ranking to make better decisions.

2. Literature Review

Numerous authors have utilized different methodologies for rating various aspects of banks in order to improve banking system efficiency. Here are citations to some of the authors' notable works.

(Secme et al., 2009) evaluated the five largest commercial banks in the Turkish Banking Industry based on various financial and non-financial indicators. The suggested model incorporates the Fuzzy Analytic Hierarchy Process (FAHP) and Technique for Order Performance by Similarity to the Ideal Solution (TOPSIS) for ranking the banks. The results indicated that both financial and non-financial performance should be considered while evaluating a bank's performance.

With regards to deposit mobilization, credit channelization, credit-deposit (C/D) ratio, deployment of credit to various occupations, etc., (Ahmed, 2015) assessed the effectiveness of RRBs in India. According to his study, the credit per office of RRBs is significantly lower compared to commercial banks in India, indicating that RRBs are not in a position to deploy credit for socio-economic development.

(Darnel & Das, 2020) analyzed the financial performance of selected North Eastern Regional Rural Banks from 2014 to 2018. The data was evaluated using various CAMEL model ratios. The survey revealed that Assam Gramin Vikash Bank and Mizoram Rural Banks performed significantly better than Tripura Gramin Bank and Arunachal Pradesh Rural Bank.

Using Analytical Hierarchy Process, (Kumar et al., 2020) examined the financial health of ten commercial banks operating in India. The results of the study indicate that the capital adequacy ratio is the most important criteria chosen for investigation. In addition, the ranking of banks reveals that the importance of financial ratio is greater than that of bank size in determining their financial success.

Turkish commercial banks were evaluated for their efficacy and output before and after COVID-19 using an integrated MCDM approach (Ünlü et al., 2022). Using a unique integrated MCDM strategy that incorporated the subjective weighting method SWARA II, the objective weighting method MEREC, and the ranking tool MARCOS, the paper assessed bank efficiency and production. The results show that throughout the COVID-19 period, banks with foreign investors were more productive than other bank groups and that state banks' productivity fell significantly.

Using a time horizon, (Bhagwat & Hedau, 2022) analyzed the performance of selected Indian and foreign banks in India to find any performance change over time. Initially, the performance of the selected banks was evaluated based on their management efficiency using the MCDM technique. According to the weights determined using fuzzy logic of geometric mean, 'customized services' are an essential criterion, followed by 'competitiveness,' 'cost-effectiveness,' 'efficiency,' and 'client influx reduction' for banks.

(Sama et al., 2022) analyzed the performance of Indian private sector banks using a variety of multi-criteria decision-making methodologies. CRITIC, TOPSIS, and Grey Relational Analysis, were used to examine the data. The analysis indicated that HDFC is the most successful private sector bank and establishes a benchmark.

It is evident from the preceding studies that the financial performance and condition of North Eastern Regional Rural Banks is not particularly clear. In light of this context, the purpose of the present study is to evaluate and rank the RRBs of chosen North-Eastern regions. Furthermore, the study will aid stakeholders in improving the operation of RRBs by implementing appropriate measures.

3. Methodology

3.1 Multi-Criteria Decision Making (MCDM)

Multi-criteria decision-making methods include diverse values and domain types while ensuring that these entities do not translate explicitly into a common domain (W, 2021). The method is applied to various situations, from choosing a car or laptop to determining the finest banks.

A MCDM may be represented by a two-dimensional matrix referred to as the performance matrix depicted in Table I.

European Economic Letters
ISSN 2323-5233
Vol 13, Issue 5 (2023)
http://eelet.org.uk

Table I. Performance Matrix

Alternatives		Criterion			
		C_1	C_2	.....	C_n
	a_1	v_{11}	v_{12}	.....	v_{1n}
	a_2	v_{21}	v_{22}	.....	v_{2n}
	.	.	.	.	
		.	.	.	
	a_m	v_{m1}		.....	v_{mn}

The performance matrix illustrates the relationship between available alternatives and decision-making criteria. The range of options,

A= {A_1, A_2, A_3,...,A_n} creates rows, and

Set of Criteria,

C= {C_1, C_2, C_3,...,C_n} constitutes the columns of the performance matrix.

Each cell, V_{ij}, represents the preference of the decision maker for alternative i with regard to criterion j.

3.2 Analytic Hierarchy Process (AHP)

Thomas Saaty established the most prominent MCDM technique, Analytic Hierarchy Process (AHP), in 1980. AHP has been applied to a greater variety of problems than any other MCDM technique. Figure 1 demonstrates the application of several well-known bank ranking methods.

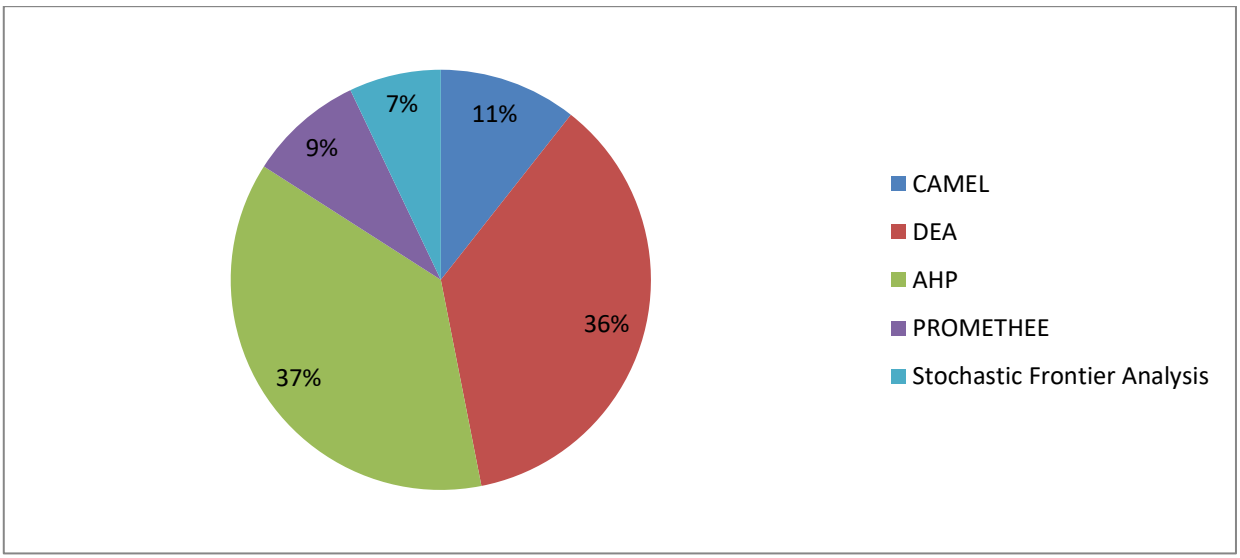

Figure 1. Methods Used for Ranking Banks

The AHP is a useful tool for resolving difficult decision-making issues to establish priorities and make the optimal choice. It permits examining qualitative and quantitative criteria (Saaty, 1987). Researchers implemented AHP in recommender systems to choose a (mobile phone, automobile, etc.), cloud computing adoption, determine a job, and allocate organization resources (Priyadarshinee *et al.*, 2017). Hierarchical models are used to represent the issue. The objective, criteria, sub-criteria, and alternatives are presented in the form of a tree. Using Saaty's comparison table illustrated in Table II, decision-makers must assess each criteria by assigning preference values to the superior criteria.

European Economic Letters
ISSN 2323-5233
Vol 13, Issue 5 (2023)
http://eelet.org.uk

Table II. Fundamental Pair-wise Comparison Scale for AHP Preferences

The Fundamental Scale for Pairwise Comparisons		
Intensity of Importance	**Definition**	**Explanation**
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation
Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance.		

Source: (Saaty, 1990)

The result of the AHP is a ranked list that indicates the overall preference for each decision alternative. AHP permits a little degree of variability in judgment, as humans are not always consistent. By using Table III, Consistency Ratio is calculated so that values above 0.10 indicate inconsistent assessments. The AHP method's consistency check mechanism assures that decision-makers make consistent judgments.

Table III. The Random Index Table

Random index (RI)															
N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.58

Source: (Saaty, 1980)

Despite the widespread implementation of the AHP methodology in commercial and industrial settings, deploying this method in the financial system was relatively uncommon until 2019. Figure 2 depicts the rising applicability of AHP for rating banks, as well as the year-by-year utilization of various approaches for the purpose. Many studies on a global scale have utilized MCDM tools to conduct performance evaluations on various entities (Shashi and Yadav, 2009). But, the use of AHP for decision-making and ranking the North Eastern RRBs is yet to be done.

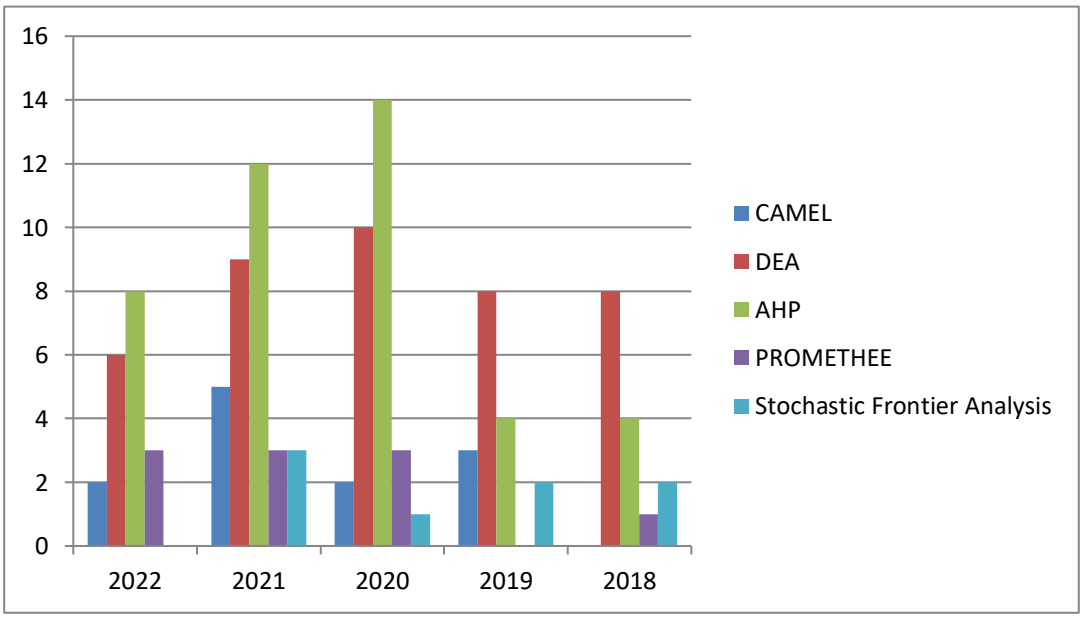

Figure 2. Year wise use of Various Methods for Ranking of Banks

Steps involved in the AHP process:

- The first step of the AHP process is establishing the hierarchy model for interrelated decision elements, which includes the most significant criteria for evaluating the problem statement. Each criterion contains several potential alternatives examined at different levels of the hierarchy.
- The subsequent stage involves pair-wise comparisons to offer judgments of the criteria at one level and comparisons of the alternatives at different levels.
- The final phase involves synthesizing the alternatives' priorities and identifying the optimal solution among the options offered.

The set of criteria (C) is designed which contains all the criteria responsible for the evaluation process. C= {Cj | j= 1,2,3,.....,n}. Each criterion is compared in a pair-wise fashion forming a Square matrix (n x n).

$$A= \begin{bmatrix} a_{11} & . & . & a_{1n} \\ . & . & . & . \\ . & . & . & . \\ a_{n1} & . & . & a_{nn} \end{bmatrix} \quad (1)$$

Normalized Matrix is generated by the following equation:

$$v_{ij} = \frac{a_{ij}}{\sum_{i=j}^{n} a_{ij}} \quad (2)$$

After the normalization matrix is obtained, Criteria weight for each alternative is calculated by the method:

$$\text{Criteria weight} = \frac{\sum_{j=1}^{n} v_{ij}}{n} \quad (3)$$

The consistency of the pair wise comparison judgment relates to the output of the AHP method. The consistency among the entries is defined by

$$\text{Consistency} = \text{Criteria Weight} * a_{ij}$$

$$\text{Weighted Sum Value} = \sum_{j=1}^{n} v_{ij} \quad (4)$$

The criteria matrix is normalized and relative weights are derived. Eigen vector (V) gives the relative weights corresponding to the largest eigenvalue (λ_{max}).

$$\lambda_{max} = \text{Avg}\left(\frac{weighted\ sum\ value}{criteria\ weight}\right) \quad (5)$$

Finally, Consistency Index (CI)

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (6)$$

3.3 Data Collection

The annual reports of the selected North Eastern RRBs are scoured for information pertaining to three financial years in order to meet the specific aims of this study. For the study, primary data were gathered from bank employees and customers, which helped analyze the data and draw conclusions. Using the Multi-Criteria Decision Making Method (MCDM), data were evaluated. AHP is utilized to determine the subjective weights of the variables. Five North Eastern Regional Rural Banks were selected for the current study: Assam Gramin Vikash Bank, Manipur Rural Bank, Meghalaya Rural Bank, Mizoram Rural Bank, and Tripura Gramin Bank.

The banks are evaluated using three criteria: Finance, Customer, and Non-Finance (Cuong *et al.*, 2018). The questionnaire and feedback method were considered while assigning numerical values to each attribute and establishing criteria for rating the attributes. The hierarchical model for evaluating the bank's financial performance was constructed by placing the objective (i.e., Evaluation of performance) at the top (1st level), followed by the criteria (3 criteria) and sub-criteria (12 sub-criteria) at the 2nd and 3rd levels, respectively, and the alternatives (5 North East RRBs) at the bottom (4th level). Figure 3 shows the proposed AHP model.

The segmentation of criteria, sub-criteria, and alternatives is intended to bring clarity to the evaluation process and aid in better decision-making, as the traits are gathered by considering all facets of North East RRBs banking system.

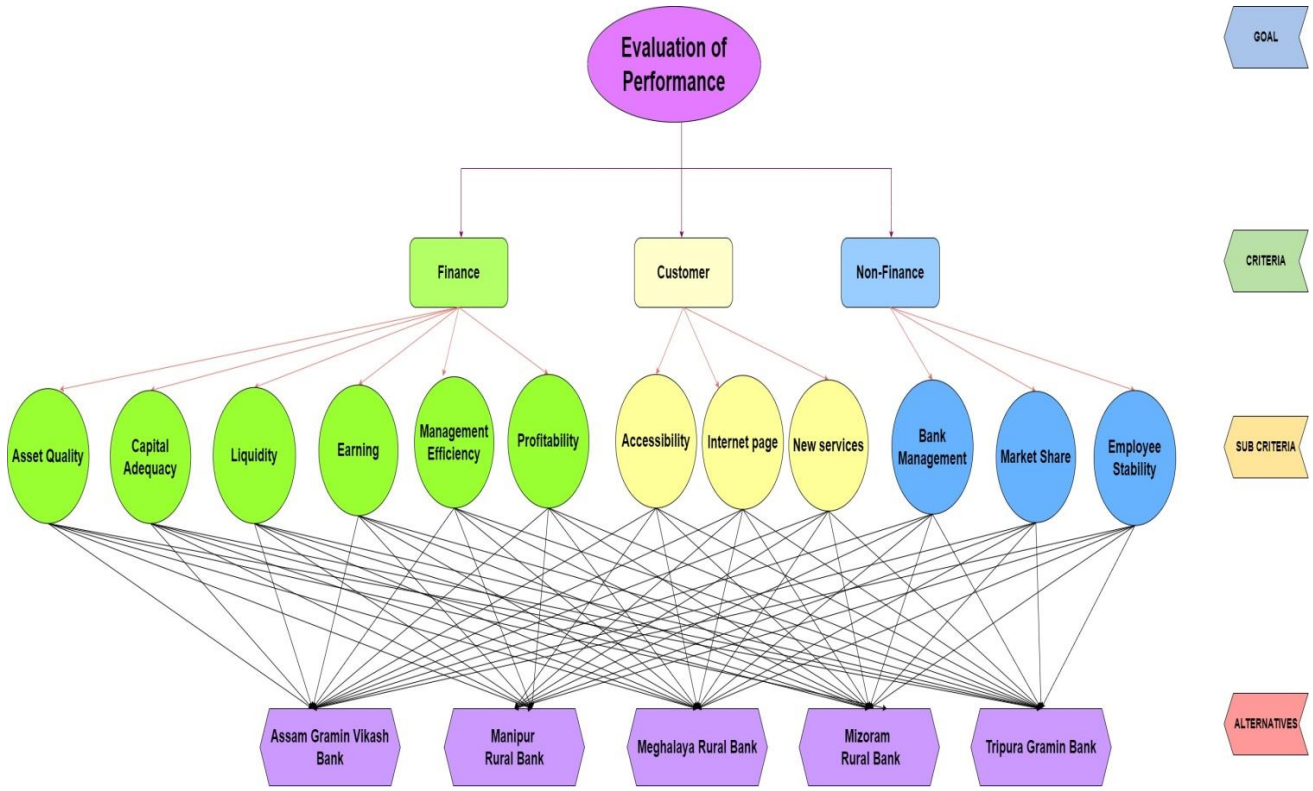

Figure 3. Proposed AHP Model

4. Overview of North East Banks

India's north-eastern area serves as a vital nexus for trade and commerce due to its proximity to India's international borders, which link 98% of the country. Despite its abundant natural resources and potential as a cross-border trading hub, the part is one of India's most economically disadvantaged areas. In light of this, a thorough examination of the financial and non-financial health of banking in the North East Region is crucial to the growth of trade and commerce in these areas.

Table IV. Profile of North East India

Administrative Divisions	**7 States (Assam, Meghalaya, Manipur, Arunachal Pradesh, Sikkim, Mizoram, and Tripura).**
Total Population	**45,772,188**
Total Area	**262,179 km^2 (101,228 sq mi)**

European Economic Letters
ISSN 2323-5233
Vol 13, Issue 5 (2023)
http://eelet.org.uk

Table V. Banking Status of North East India

State	C-D percentage	
	(As at 2021 March end)	(As at 2022 March end)
Assam	46.7	48.9
Arunachal Pradesh	25.2	24.5
Manipur	57.7	60.2
Meghalaya	37.6	32.0
Mizoram	42.0	45.4
Nagaland	43.2	43.0
Tripura	42.1	41.9
NES (North Eastern States)	44.1	44.8

Source: RBI Table 144: State-wise Credit-Deposit Ratio of Scheduled Commercial Banks According to Place of Sanction

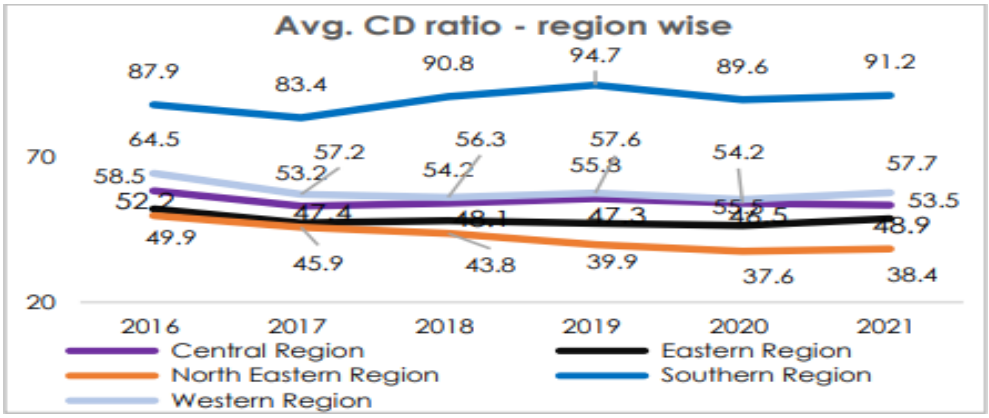

Figure 4. Region Wise Average C-D Ratio

Source: NABARD Research Study-28

North-eastern India is one of the country's most isolated regions with low financial inclusion (Sangwan, 2006). This is evidenced by the fact that the North Eastern States have a more significant average population per bank branch than India as a whole. The Credit-Deposit (C-D) ratio in the North Eastern States is significantly lower than the national average as shown in Figure 4. Persistent interregional differences impede India's progress in terms of financial inclusion, notwithstanding its progress in this area. Therefore, it is crucial to evaluate the country's geographically isolated and less developed North-Eastern states (Bora, 2020).

There are various reasons why banks in the North East cannot expand. The high topography of the North East of India makes it difficult for financial institutions such as banks to operate there. It is also susceptible to natural disasters such as landslides and floods, which increases the risk for banks and other financial institutions operating in the North East. Due to this, it is challenging to link micro lending operations to a source of income (Boro, 2015). In addition, the region is characterized by a substantial number of indigenous people. A large variety of ethnicities, languages, and cultures is a restriction. In the Northeast, bringing individuals together is substantially more expensive. Unfortunately, despite the region's abundant natural resources, its growth and development are limited by a lack of coordination among these resources, their control, and their scientific management (Adhikari *et al.*, 2015). Therefore, it is vital to review banks and aid them in enhancing their social role image.

5. Data Analysis

From the selected banks' annual reports and NABARD's Key Statistics & Financial Statements of RRBs, we compile data on six criteria, measured by twenty-three sub-criteria in terms of financial ratios, to use the suggested model to evaluate

the financial performance of North Eastern RRBs in India. The analysis uses the average time-series data for the fiscal years 2019-2020, 2020-21, and 2021-2022. The decision matrix illustrated in Table VI employs the average of these ratios.

Table VI. Average Financial Ratios of Selected Criteria

Alternative's (Selected Banks) ***Criteria's (Financial Ratios)***	**Assam Gramin Vikash Bank**	**Manipur Rural Bank**	**Meghalaya Rural Bank**	**Mizoram Rural Bank**	**Tripura Gramin Bank**
Asset quality					
(Gross NPA/ Gross Advance)*100	**32.78**	**22.00**	**10.08**	**5.52**	**7.98**
(Net NPA/ Net Advance)*100	**22.35**	**16.29**	**2.41**	**1.45**	**0.00**
(Provisions held for NPA/GNPAs)*100	**41.65**	**28.56**	**56.49**	**74.29**	**68.43**
Capital Adequacy					
Capital Adequacy (Teir-I)	**3.57**	**3.83**	**13.22**	**10.19**	**23.79**
Capital Adequacy (Teir-II)	**0.89**	**1.15**	**0.52**	**0.08**	**1.99**
CRAR	**4.46**	**4.98**	**13.74**	**10.27**	**25.78**
Liquidity					
(Cash in hand and balance with RBI/ Deposits)*100	**4.45**	**3.99**	**4.46**	**5.19**	**4.47**
(Advances/Deposits)*100	**35.75**	**47.56**	**29.72**	**51.01**	**36.78**
(Investment/Deposits)*100	**63.27**	**48.90**	**67.45**	**56.43**	**74.33**
(Deposits/Total liability)*100	**87.08**	**73.62**	**89.01**	**83.46**	**73.81**
Earning					
Net Interest Margin	**2.55**	**3.62**	**3.21**	**3.97**	**3.06**
(Interest Earned/ AWF)*100	**6.29**	**6.78**	**6.63**	**7.61**	**6.78**
(Other Income/ AWF)*100	**1.64**	**1.63**	**0.36**	**0.34**	**1.44**
(Operating Profit/AWF)*100	**0.27**	**-0.14**	**1.72**	**2.11**	**2.32**
Management Efficiency					
Profit per employee	**-7.01**	**-3.73**	**1.97**	**7.33**	**20.27**
Business per employee	**907.17**	**576.07**	**904.01**	**1305.09**	**1244.54**
Ratio of wage bill to total expenses	**34.94**	**41.69**	**25.27**	**14.50**	**19.61**
Ratio of wage bill to total income	**39.22**	**46.35**	**24.07**	**13.07**	**15.45**
Profitability					
ROA	**-0.93**	**-0.95**	**0.25**	**0.72**	**1.71**
ROE	**-19.47**	**-6.11**	**4.30**	**14.77**	**16.10**
(Operating profit/ total assets)*100	**0.29**	**4.55**	**1.85**	**1.87**	**2.24**
Return on advances	**6.50**	**8.72**	**9.57**	**10.58**	**10.67**

Return on Investment	**5.49**	**6.66**	**5.81**	**7.03**	**6.47**

Source: Key Statistics & Financial Statements of Regional Rural Banks

Pairwise comparisons of each of the three criteria and the twelve sub-criteria were performed for all possible combinations of criteria and sub-criteria to determine their relative importance. Table X displays the results of the selected criteria and sub-criteria. The comparison matrices are squared to compare all possible sets of items. Each cell in the matrices is assigned a numeric value according to the AHP's basic pairwise comparison scale (Table II). In Table VII, we see a sample comparison matrix filled up according to the standards used by Expert 1.

Table VII. The pairwise Comparison Matrix for the Selected Criteria

Expert 1

Comparison Matrix

	Preferred Over		
Criteria	**Finance**	**Customer**	**Non-Finance**
Finance	1	3/2	2
Customer	2/3	1	3/2
Non-Finance	1/2	2/3	1

N(N-1)/2 comparisons are performed at each hierarchy level. These pairwise comparison matrices described the superiority of one attribute over others. The pairwise comparison matrices are created by using a single reference criterion and matching it with all other criteria.

According to Saaty (1980), CR values up to 0.10 or 10 percent are considered appropriate. A more than 10% value indicates that the response acquired from the respondent is inconsistent and must be evaluated and enhanced to produce consistent matrices. In the present instance, the value of the consistency ratio for all criteria and sub-criteria is below 0.07. The reference result of a pairwise comparison matrix (Table VIII) for selected options is depicted in Table IX. Each level has yielded comparable results for consistency.

Table VIII. The Pairwise Comparison Matrix for the Selected Criteria

Asset Quality

Ratio of Gross NPA to Gross Advance

	Preferred Over				
Criteria	**Assam Gramin Vikash Bank**	**Manipur Rural Bank**	**Meghalaya Rural Bank**	**Mizoram Rural Bank**	**Tripura Gramin Bank**
Assam Gramin Vikash Bank	1	1/2	1/3	1/5	1/4
Manipur Rural Bank	2	1	1/2	1/3	1/3
Meghalaya Rural Bank	3	2	1	1/2	1/2
Mizoram Rural Bank	5	3	2	1	2
Tripura Gramin Bank	4	3	2	1/2	1

Table IX. Consistency Result of the Pair-wise Comparison Matrix for Selected Criteria

Criteria	Weight	λ max, CI, RI	CR
Assam Gramin Vikash Bank	0.063322592		
Manipur Rural Bank	0.107504475	λ max= 5.074	
Meghalaya Rural Bank	0.180354458	CI = 0.0184	CR = 0.01643
Mizoram Rural Bank	0.375302542	RI = 1.1	
Tripura Gramin Bank	0.273515933		

Table X displays the computed local and global weights of all sub-criteria based on the financial performances of the selected banks for the selected ratios and the responses provided by the experts and customers.

Table X. Weights of Each Criteria by AHP

~~Criteria~~	~~Local~~	~~Overall~~
(C1) Finance	**0.459889**	
(SC11) Asset quality	**0.179938**	
(SC111) Ratio of Gross NPA to Gross advance	0.338614	**0.028021**
(SC112) Ratio of Net NPA to Net advance	0.351398	**0.029079**
(SC113) Provision Coverage Ratio	0.309988	**0.025652**
(SC12) Capital Adequacy	**0.174364**	
(SC121) Capital Adequacy (Tier-I)	0.333465	**0.026740**
(SC122) Capital Adequacy (Tier-II)	0.301960	**0.024214**
(SC123) CRAR	0.364575	**0.029235**
(SC13) Liquidity	**0.159117**	
(SC131) Cash to Deposit Ratio	0.275878	**0.020188**
(SC132) Credit to Deposit Ratio	0.221016	**0.016173**
(SC133) Investment to Deposit Ratio	0.243313	**0.017805**
(SC134) Deposit to Total liability	0.259793	**0.019011**
(SC14) Earning	**0.172828**	
(SC141) Net Interest Margin	0.260253	**0.020685**
(SC142) Ratio of interest Income to Total Assets	0.284603	**0.022621**
(SC143) Ratio of Non-interest Income to Total Assets	0.214883	**0.017079**
(SC144) Operating Cost to Operating Income	0.240261	**0.019096**
(SC15) Management Efficiency	**0.150706**	
(SC151) Profit per employee	0.259336	**0.017974**
(SC152) Business per employee	0.289665	**0.020076**
(SC153) Ratio of wage bill to total expenses	0.238473	**0.016528**
(SC154) Ratio of wage bill to total income	0.212526	**0.014730**
(SC16) Profitability	**0.163046**	
(SC161) Return on Assets (ROA)	0.200275	**0.015017**
(SC162) Return on Equity (ROE)	0.213036	**0.015974**

(SC163) Ratio of operating profit to total assets	0.206760	**0.015504**
(SC164) Return on Advances	0.192349	**0.014423**
(SC165) Return on Investment	0.187580	**0.014065**
(C2) Customer	**0.318938**	
(SC21) Accessibility	0.311905	**0.099478**
(SC22) Internet Page	0.490476	**0.156432**
(SC23) New services	0.197619	**0.063028**
(C3) Non Finance	**0.221172**	
(SC31) Bank Management	0.347009	**0.076749**
(SC32) Market Share	0.199145	**0.044045**
(SC33) Employee Stability	0.453846	**0.100378**

To get the preference score, the values of every sub-criterion in the weighted normalized choice matrix were added that corresponds to each bank. This preference score is used to rank the banks in order of preference. As displayed in Table XI.

Table XI. Ranking of Selected North Eastern RRBs

CBs	CCi	Rank
Assam Gramin Vikash Bank	0.164689	4
Manipur Rural Bank	0.164068	5
Meghalaya Rural Bank	0.192840	3
Mizoram Rural Bank	0.231550	2
Tripura Gramin Bank	0.246853	1

6. Results and Discussions

This study evaluated five North Eastern Regional Rural Banks under 29 financial and non-financial criteria. In addition, this study developed an integrated multi-criteria decision-making AHP method to determine the weight of criteria and the evaluation rate for these five banks under each criterion.

The AHP technique revealed the relative importance of each criterion; for instance, Table X demonstrates that the financial criteria are the most influential on the bank's success (0.459889), followed by the customer perspective (0.318938) and the qualitative criteria (0.221172). Keeping up a high level of performance requires the banking system to improve financial indicators, maintain the loyalty and trust of customers, and create new markets to attract new customers. This is because the banking industry is a specialized service sector whose performance is closely related to customer satisfaction.

The weights of selected criteria and sub-criteria is determined using the paired comparison approach and the AHP responses of banking experts. The Asset quality has the highest weight (0.179938), followed by Capital Adequacy (0.174364), Earnings (0.172828), Profitability (0.163046), Liquidity (0.159117), and Management Efficiency (0.150706), which has the lowest weight. Similarly, for Non-Finance amongst the three selected sub-criteria, Employee Stability (0.453846) has the highest weightage, followed by Bank Management (0.347009) and Market Share (0.199145). The questionnaire method is used to collect customer perceptions about the RRBs. Amongst the selected sub-criteria,

ease of doing online transactions and gathering information through an Internet page (0.490476) has the highest weightage, followed by accessibility (0.311905) and New Services (0.197619) having the least weightage amongst all.

The ranking is determined by the preference score. The higher the overall preference scores higher the ranking. The overall highest preference score for 'finance' was of Tripura Gramin Bank (0.155499), and the lowest was Assam Gramin Vikash Bank (0.071389). Likewise, for the 'Non-financial' criteria, Mizoram Rural Bank (0.044887) has the highest preference score, followed by Tripura Rural Bank (0.044744), and the lowest preference score was of Meghalaya Rural Bank (0.044213). The overall highest preference score for the second criterion, 'Customer,' was of Tripura Gramin Bank (0.067999), followed by Assam Gramin Vikash Bank (0.066711) and Manipur Rural Bank (0.055806).

In addition, we established the final value to rank five banks and provide the average level of satisfaction among the five. Table XI demonstrates that the bank with the best performance (Tripura Gramin Bank) is more dominant than other RRBs in financial metrics. Additionally, qualitative criteria are also good. In contrary, the Manipur Rural Bank has demonstrated the weakest performance of the five proposed banks. It can be explained by poor financial performance and a lack of client involvement, with financial criteria being the most influential on bank performance.

7. Conclusion

In an era of ferocious competition; expansion, and intensification hinge on calculating performance and making appropriate decisions. The proposed work measured the performance of North Eastern RRBs and ranked them based on their performance using the AHP approach.

When applied to evaluation criteria containing qualitative and quantitative criteria with unclear input data, this model's linguistic variables helped simplify the decision-making process. Following is a study that may be used in the proposed model to find a solution for all banks in the system and evaluate the outcomes in light of other decision-making models.

It was discovered that the North Eastern region is vulnerable to expansion and development in the financial, technological, and industrial sectors due to a lack of infrastructure, inadequate connection, and unreliable power supply. Meanwhile, a decline in agricultural growth and a sluggish industrial and service sector has limited people's livelihood options. Moreover, RRBs have been dissuaded from disbursing loans due to their unprofitable lending activities. This is why the Credit-Deposit (C-D) ratio in the North Eastern States is significantly lower than the ratio for India. The study concludes that the overall performance of Tripura Gramin Bank is good in comparison to the other selected banks.

Research extent a scope for future research, the method used in the present study can be compared with other MCDM methods and also taking into consideration other input and output criteria. Further research can be extended for the additional time period.

References

1. Adhikari, K., Pinkumoni, M., K., Bhusan, N., & D. (2015), "Performance of Assam Gramin Vikash Bank-an Analytical Study", *Gurukul Business Review (GBR)*, 11(Spring), 19–23.
2. Agrawal, V., Seth, N., & Dixit, J. K. (2022), "A combined AHP–TOPSIS–DEMATEL approach for evaluating success factors of e-service quality: an experience from Indian banking industry", *In Electronic Commerce Research (Vol. 22, Issue 3). Springer US.* https://doi.org/10.1007/s10660-020-09430-3.
3. Ahmed, J. U. din. (2015), "Performance Evaluation of Regional Rural Banks: Evidence from Indian Rural Banks", *Global Business Review, 16, 125–139.* https://doi.org/10.1177/0972150915601259.
4. Bhagwat, A. R., and M. Hedau. (2022), "AHP model on the assessment of technological innovation in banking sector (with reference to Indian and foreign banks". vol 10: 424-429.
5. Bora, N. M. (2020), "Financial inclusion in India*:* A case study of the north-eastern states", *International Journal of Scientific and Technology Research, 9(2), 1319–1323*.
6. Boro, K. (2015), "Prospects and challenges of technological innovation in banking industry of North East India", *Journal of Internet Banking and Commerce, 20(3).* https://doi.org/10.4172/1204-5357.1000134.

7. contributors, W. (2021), "Multiple-criteria decision analysis - Wikipedia. In The free encyclopedia." https://en.wikipedia.org/wiki/Multiple-criteria_decision_analysis.
8. Cuong, D. X., Hien, H. T., & Long, T. (2018), "Multi-criteria Decision-Making model evaluating the performance of Vietnamese commercial banks", *International Journal of Financial Research*, 9(1), *132–141*. https://doi.org/10.5430/ijfr.v9n1p132.
9. Dharnal, D. & Das, J. (2020), "A Study on Selected Regional Rural Banks of the NE Region of India using the Camel Model" https://www.researchgate.net/publication/342591056_Performance_Analysis_of_Selected_Indian_Public_Sector_Banks_and_Private_Sector_Banks_Using_CAMEL_Model
10. HemaMalini, B. H., Suresh, L., & Kushal, M. (2020), "Comprehensive Analysis of Students' Performance by Applying Machine Learning Techniques", *In Smart Innovation, Systems and Technologies (Vol. 160)*, https://doi.org/10.1007/978-981-32-9690-9_60.
11. History of Regional Rural Banks (RRBs) (pp. 1–7). (n.d.).
12. Chatterjee, D & Mithali (2022), "India Post Payments Bank_ Overcoming distance and distrust amongst the unbanked - Microsave. (n.d.)"
13. Kumar, P., Sharma, D., & Singh, R. (2020), "Financial Performance Evaluation of Commercial Banks by AHP: An Evidence from India*", Pacific Business Review International, 12(12), 21–37.*
14. Mahalik, D. K. (2020), "Ranking Performance of Indian Public Sector Banks using AHP and TOPSIS Measuring The Performance of Banks Using Combination of AHP-Vikor Analysis", https://www.researchgate.net/publication/324686294_Ranking_Performance_of_Indian_Public_Sector_Banks_using_AHP_and_TOPSIS.
15. Misra, B. S. (2006), "The Performance of Regional Rural Banks (RRBs) in India : Has Past Anything to Suggest for Future?", *Reserve Bank of India Occasional Papers, 27(1), 89–118*. https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/73534.pdf
16. Mukherjee, P., Pattnaik, P. K., Al-Absi, A. A., & Kang, D. K. (2021), "Recommended system for cluster head selection in a remote sensor cloud environment using the fuzzy-based multi-criteria decision-making technique", *Sustainability (Switzerland), 13(19).* https://doi.org/10.3390/su131910579.
17. Priyadarshinee, P., Jha, M. K., Raut, R. D., Kharat, M. G., & Kamble, S. S. (2017), "To identify the critical success factors for cloud computing adoption by MCDM technique", *International Journal of Business Information Systems, 24(4), 469–510.* https://doi.org/10.1504/IJBIS.2017.082888.
18. Raj, R., & Das, A. (2019), "Drivers of Credit Penetration in Eastern India", *RBI Bulletin, 100385, 113–122.*
19. RRBsCAMEL (1). (n.d.).
20. Saaty, R. W. (1987), "The analytic hierarchy process-what it is and how it is used", *Mathematical Modelling, 9(3–5), 161–176.* https://doi.org/10.1016/0270-0255(87)90473-8.
21. Saaty, T. L. (1988), "WHAT IS THE ANALYTIC HIERARCHY PROCESS ?", *Springer Berlin Heidelberg.* https://link.springer.com/chapter/10.1007/978-3-642-83555-1_5
22. Saaty, T. L. (1990), "How to make a decision: The analytic hierarchy process", *European Journal of Operational Research, 48(1), 9–26*. https://doi.org/10.1016/0377-2217(90)90057-I.
23. Sabitha, N., & Professor, D. A. (2014), "Problems and Prospects of Regional Rural Banks in India", *International Journal of Managerial Studies and Research, 2(3), 69–72.* www.arcjournals.org.
24. Sahoo, B., Behera, R. N., & Pattnaik, P. K. (2022), "A Comparative Analysis of Multi-Criteria Decision Making Techniques for Ranking of Attributes for e-Governance in India". *International Journal of Advanced Computer Science and Applications*, 13(3).
25. Sama, H. R., Kosuri, S. V. K., & Kalvakolanu, S. (2022), "Evaluating and ranking the Indian private sector banks—A multi-criteria decision-making approach", *Journal of Public Affairs, 22(2).* https://doi.org/10.1002/pa.2419.
26. Seçme, N. Y., Bayrakdaroğlu, A., & Kahraman, C. (2009), "Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS", *Expert Systems with Applications, 36(9), 11699–11709.* https://doi.org/10.1016/j.eswa.2009.03.013.

27. Shashi, B., & Yadav, S. R. (2009), "AHP Application in Banking: Unfolding Utility in a Situation of Financial Crisis", July 2009. https://doi.org/10.13033/isahp.y2009.008.
28. Sangwan, S. (2006), "Financial Inclusion and Self Help Groups (An Abstract)".
29. Ünlü, U., Yalçın, N., & Avşarlıgil, N. (2022), "Analysis of Efficiency and Productivity of Commercial Banks in Turkey Pre- and during COVID-19 with an Integrated MCDM Approach", *Mathematics, 10(13).* https://doi.org/10.3390/math10132300.
30. ZhengHua, H. S. Wang, and Chih-Ling Chuang (2010), "A fuzzy AHP and DEA approach for making bank loan decisions for small and medium enterprises in Taiwan". *Expert Systems with Applications 37.10: 7189-7199.*