Computational Intelligence for Sustainable Banking: A Novel Fermatean Fuzzy LOPCOW–EDAS Framework

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***Abstract*—The primary objective of this study is to identify the priority strategies required for banks to achieve their sustainable growth targets and to develop a new fuzzy multi-criteria decision-making model sensitive to uncertainty conditions. The model proposed in this study is designed based on the integration of Fermatean Fuzzy LOPCOW–EDAS. In the first stage, the criteria and strategic alternatives affecting sustainable growth were identified through a literature review. The LOPCOW method was then used to objectively calculate the criteria's importance weights. The prioritization of strategic alternatives was then performed using the EDAS method. To more accurately model the uncertainties in expert judgments, the opinions of ten experts were converted to the Fermatean fuzzy numbers and analyzed. The use of Fermatean fuzzy sets offers greater expressive power and increases decision reliability compared to traditional fuzzy and Pythagorean approaches. The LOPCOW method objectively evaluates the information density of the criteria by using logarithmic percentage change, while the EDAS method reduces the impact of outliers by considering the distance of the alternatives from the mean solution, producing a more stable ranking. The findings indicate that the "digital green banking practices" criterion is the most critical element for sustainable growth. Furthermore, the "Digitalization and innovation capability" strategy was determined to be the most important alternative. This result demonstrates that sustainable growth in the banking sector can be achieved through the integration of digital technologies and environmentally friendly practices.**

***Keywords*—Fermatean fuzzy sets; multi-criteria decision-making; sustainable banking; digital transformation; decision support systems**

I. Introduction

Sustainable growth in the banking sector is a key concern for regulators, investors, and bank management, especially in the face of global challenges such as climate change, the digital economy, and market uncertainty [1]. Banking is a financial intermediary that plays an important role in maintaining economic stability. Therefore, banks, being business entities, must focus on their financial performance to achieve sustainable growth [2]. Sustainable growth is an indicator of banking sustainability [3]. The concept of sustainable growth in the banking context encompasses not only consistent profit growth but also anticipates financial risk, ensures capital adequacy, promotes regulatory compliance, fosters good corporate governance, and addresses the social and environmental impacts of banking activities [4].

The issue of sustainable growth in banking aligns with Sustainable Development Goal 8 (SDG-8), specifically Decent Work and Economic Growth. Banking plays a crucial role in driving economic growth by serving as a financial intermediary [5]. It has the potential to create decent jobs by distributing funds to support business activities in various fields [6]. Sustainable growth measurement in this study refers to the maximum internal growth that can be achieved by utilizing retained earnings to fund the expansion of banking assets [7]. Meanwhile, measuring sustainable growth in the banking sector is not only relevant from a financial perspective but also promotes an inclusive and responsible financial system. Therefore, this study aims to detect the predictors of sustainable banking growth, which consist of financial factors, namely credit risk and capital adequacy, and non-financial factors, namely governance, audit quality, and green banking.

Achieving sustainable growth in the banking sector is directly related not only to the continuity of profitability indicators but also to the strategic management of resources. In this context, developing prioritized strategies for effective budget management is a critical requirement for banks. Budget allocations made without establishing sustainable growth strategies can lead to inefficient resource use, increased operational costs, and weakened long-term financial stability. Effective budget management forms the basis of sustainable growth not only in terms of financial indicators but also in dimensions such as corporate governance, risk management, audit quality, and environmental responsibility. However, a review of the existing literature reveals that studies focusing on the prioritized strategy-setting processes for achieving sustainable growth in banks are quite limited. Most studies address the concept of sustainable growth through the lens of financial performance or environmental sustainability, but they fail to provide an analytical framework for determining which strategies should be prioritized. This creates a significant research gap in the literature and prevents banks from systematically structuring their sustainable growth policies. Failure to define strategic priorities hinders decision-makers' ability to achieve long-term growth targets and, by directing resources in the wrong areas, leads to productivity losses, capital shortages, and increased operational risks. Therefore, to implement sustainable growth at the corporate level, the need for analytical models that enable banks to identify their strategic priorities from a multi-criterion, holistic perspective is greater than ever. Such a prioritization approach will not only increase banks' internal efficiency and budget management effectiveness but will also significantly contribute to the rational and measurable achievement of sectoral sustainability goals.

The aim of this study is to develop a holistic and analytical framework for determining priority strategies for achieving sustainable growth in the banking sector. While numerous studies on sustainable growth exist in the literature, a multi-criteria analysis approach is lacking to determine which strategies banks should prioritize to achieve this growth. This constitutes the primary motivation for this research. To address this research gap, the study proposes a new fuzzy multi-criteria decision-making model that considers both financial and non-financial performance indicators of banks. The developed model is based on the Fermatean Fuzzy Set approach to more reliably analyze uncertain and subjective expert judgments. The research methodological process consists of four stages. In the first stage, a comprehensive literature review is conducted to identify the criteria affecting banks' sustainable growth strategies and potential strategy alternatives. In the second stage, the importance of these criteria is objectively weighted using the LOPCOW method. In the third stage, the priority ranking of strategic alternatives is performed using the EDAS method. In the fourth stage, to enhance the model's ability to reflect uncertainty, the judgments obtained from 10 experts are converted into the Fermatean fuzzy numbers and incorporated into the analysis process. Thus, a hybrid decision model that evaluates both quantitative and qualitative factors is developed. Within this framework, the study seeks to answer the following research questions: 1) Which strategic factors should be prioritized for banks to achieve sustainable growth? 2) What is the hierarchical priority relationship between the importance levels of these strategies? 3) What analytical advantage does the Fermatean fuzzy LOPCOW–EDAS model, integrated with expert opinions, provide in determining sustainable growth strategies? The answers to these research questions aim to provide a scientific basis for banks' strategic decision-making processes regarding budget management, resource allocation, and long-term growth policies.

This study develops an original decision model based on the integration of Fermatean fuzzy LOPCOW–EDAS to prioritize banks' sustainable growth strategies, thus providing both a new methodological approach and an analytical contribution to the literature from a strategic management perspective. The decision-making model proposed in this study offers several methodological and analytical advantages over existing multi-criteria decision-making approaches. 1) First, the use of Fermatean fuzzy sets in the model is a significant innovation. While traditional fuzzy sets (Zadeh-type), intuitionistic fuzzy sets (IFS), and Pythagorean fuzzy sets can express expert judgments under uncertainty within certain limits, Fermatean fuzzy sets expand these limits, allowing greater flexibility in the sum of membership and opposing membership degrees. This feature allows for more realistic modeling of the high uncertainty and conflicting assessments among expert opinions frequently encountered in financial decision-making environments. Furthermore, the Fermatean approach more robustly represents experts' hesitation levels, increasing decision-making reliability and model explanatory power in multidimensional and highly uncertain contexts such as sustainable growth strategies. 2) The LOPCOW method used in this study outperforms other techniques in the literature in determining criteria importance weights. Methods such as AHP, Entropy, CRITIC, or SWARA either rely on subjective expert judgments or fail to account for variance among criteria. In contrast, LOPCOW objectively assesses the discriminatory power of each criterion by measuring the information density of criteria with a mathematical structure based on logarithmic percentage changes. This enables a more balanced weighting of multidimensional financial and non-financial criteria affecting banks' sustainable growth strategies. Thus, the model both reduces reliance on subjective evaluations and provides a significant advantage in terms of objectivity and computability by determining criteria importance based on data. 3) The EDAS (Evaluation Based on Distance from Average Solution) method used to rank strategy alternatives also provides significant advantages to the model. While methods frequently used in the literature, such as TOPSIS, VIKOR, COPRAS, or MARCOS generally make comparisons based on ideal or anti-ideal solutions, the EDAS method produces a more balanced ranking by considering the positive and negative distances of each alternative from the average solution. This approach reduces the influence of outliers, protects decision results from oversensitivity, and enables more stable strategic priorities. Furthermore, when used with Fermatean fuzzy data, the EDAS method can handle expert assessments containing uncertainty with greater statistical consistency, thereby increasing both the robustness and decision accuracy of the model. In these respects, the proposed model distinguishes itself significantly from existing models in the literature by providing both methodological depth and analytical flexibility in prioritizing sustainable growth strategies.

The remainder of the study is as follows: Section II evaluates the missing part in the literature. Section III explains the steps in the proposed methodology. Section IV highlights the main analysis results. Section V consists of the concluding remarks.

II. Literature Review

Stakeholder theory supports banks in enhancing risk management through the active participation of various groups, including customers, employees, communities, and regulators. By considering the perspectives of various parties, banks can detect and manage risks, as well as implement green banking practices [8]. By involving stakeholders, banks can promote sustainable growth that provides value to all stakeholders [9]. Financial factors are related to credit risk and capital adequacy. Credit risk is the risk of loss that arises when a borrower is unable to meet its payment obligations as agreed upon with the bank, the lender [10]. Credit risk is proxied by non-performing loans (NPL), as stipulated by the Financial Services Authority of Indonesia in Regulation No. 15/POJK.03/2017, Article 3, paragraph d, which states that NPL must not exceed 5% of total loans. Meanwhile, banks that maintain sustainable growth also need to pay attention to capital adequacy to avoid disrupting banking operations. The capital adequacy ratio (CAR) is a ratio used to assess a bank's ability to absorb potential losses arising from credit, market, or operational risks. The minimum CAR that banks must meet, according to Regulation of the Financial Services Authority No. 11/POJK.03/2016 on the Obligation to Provide Minimum Capital for Commercial Banks, ranges from 10% to 14%.

Non-performing loans (NPLs) are a component of financial factors. NPLs represent credit risk, where debtors fail to meet their obligations or default on payments [11]. An NPL ratio exceeding 5% indicates poor banking performance, which can lead to a decline in bank liquidity, disrupt the efficiency of banking operations, increase credit risk [12], and reduce investor confidence [13]. The study's results indicate that NPLs, or non-performing loans, can limit banks' capacity to invest in sustainable and environmentally friendly practices [14]. Banks require adequate capital to conduct their business activities. Regulation of the Financial Services Authority number 11/POJK.03/2016 concerning minimum capital requirements for commercial banks stipulates that the Capital Adequacy Ratio (CAR) for commercial banks in Indonesia is 10%-14%. Banks are considered sufficiently healthy to bear the risks from their lending and investment activities [15]. The Capital Adequacy Ratio (CAR) is used to assess the financial condition of banks, particularly in evaluating the extent to which banks can bear losses and risks [16], ensuring their operational activities and sustainability are maintained [17].

Non-financial factors include governance, audit quality, and green banking [18]. Banking governance refers to the process of control and direction exercised by the board of directors and senior management [19]. This process involves establishing strategic direction, overseeing daily operations, and fulfilling responsibilities to shareholders and other key stakeholders [20]. In addition to organizational structure and decision-making processes, banking governance also plays an important role in managing credit risk and maintaining the quality of loan portfolios to sustain banking operations [21]. A governance performance score measures governance as part of the environmental and social governance score, which includes: 1) board structure, 2) ethics and compliance, 3) transparency and reporting, and 4) shareholder rights and risk management. Meanwhile, to guarantee the quality of reports to stakeholders, qualified auditors are required. Governance will increase stakeholder confidence [22]. Stakeholder confidence, as evidenced by financial support for banking entities, can enable banks to operate efficiently, thereby ensuring business continuity and growth. Meanwhile, the role of banking in improving climate change is reflected through the disclosure of green banking [23]. Banks have a responsibility to finance green businesses, and banks themselves also need to demonstrate their internal commitment to green business through the Green Banking Disclosure Index (GBDI). The total GBDI is 21 items [24]. GBDI consists of: 1) green products; banks' efforts to create environmentally friendly financial services through energy efficiency, 2) green operations; related to environmentally friendly banking operations, 3) green customers; banks' efforts to educate customers to care about the environment, and 4) green policies; banks' efforts to implement environmentally friendly policies within the bank.

Governance and sustainable growth in banking entities refer to the principles and processes used to direct and control the activities of a bank, ensuring transparency, accountability, and compliance with applicable regulations. The implementation of governance principles and mechanisms can enhance corporate performance and consistency in governance, ultimately leading to sustainable growth in the banking sector in the long term [25]. Audit quality refers to the level of conformity between audit implementation and the professional standards of public accountants, resulting in findings and opinions that are credible, impartial, and reliable to stakeholders. Audit quality can be measured based on the auditor's industry specialization [26]. An auditor who is proficient in a particular industry will have audit experience that can enhance their audit competence when performing their duties [27]. A quality audit encourages companies to present transparent financial reports and improve long-term performance growth. Green banking is a banking approach that supports environmental sustainability in both daily operations and financing. The primary objective of green banking is to mitigate the adverse environmental impact of banking activities, both directly and indirectly, such as financing projects that support environmental conservation [28]. The results of the study indicate that green banking disclosure encourages companies to improve their long-term financial performance, as reflected in sustainability growth.

III. Methodology

This section relates to the definition of methodology. This methodology is a hybrid model with LOPCOW-based EDAS with Fermatean fuzzy sets.

A. *Fermatean Fuzzy Sets*

A FFS $(\tilde{F})$ is described with Eq. (1) [29]:

$$\tilde{F} = \{s, (\mu_{\tilde{F}}(s), \vartheta_{\tilde{F}}(s)) : s \in D\} \quad (1)$$

where, μ and ϑ are the membership and non-membership degrees between zero and one. D is the universe of discourse. These degrees meet the condition in Eq. (2):

$$0 \leq \mu_{\tilde{F}}^3(s) + \vartheta_{\tilde{F}}(s) \leq 1 \quad (2)$$

Assume that $\tilde{F}$ and $\tilde{G}$ are two Fermatean fuzzy sets. Then, some arithmetic operations are established with Eq. (3) to Eq. (6):

$$\tilde{F} + \tilde{G} = \left(\sqrt[3]{\mu_{\tilde{F}}^3 + \mu_{\tilde{G}}^3 - \mu_{\tilde{F}}^3\mu_{\tilde{G}}^3}, \vartheta_{\tilde{F}}^3\vartheta_{\tilde{G}}^3\right) \quad (3)$$

$$\tilde{F} \times \tilde{G} = \left(\mu_{\tilde{F}}^3\mu_{\tilde{G}}^3, \sqrt[3]{\vartheta_{\tilde{F}}^3 + \vartheta_{\tilde{G}}^3 - \vartheta_{\tilde{F}}^3\vartheta_{\tilde{G}}^3}\right) \quad (4)$$

$$\lambda\tilde{F} = \left(\sqrt[3]{1 - \left(1 - \mu_{\tilde{F}}^3\right)^\lambda}, \vartheta_{\tilde{F}}^\lambda\right) \quad (5)$$

$$\tilde{F}^\lambda = \left(\mu_{\tilde{F}}^\lambda, \sqrt[3]{1 - \left(1 - \vartheta_{\tilde{F}}^3\right)^\lambda}\right) \quad (6)$$

The score and accuracy functions are estimated using Eq. (7) and Eq. (8), respectively.

$$SF(\tilde{F}) = \mu_{\tilde{F}}^3 - \vartheta_{\tilde{F}}^3 \quad (7)$$

$$AF(\tilde{F}) = \mu_{\tilde{F}}^3 + \vartheta_{\tilde{F}}^3 \quad (8)$$

B. LOPCOW-based EDAS with FF

LOPCOW is a weighting model. With this model, objective priority values of criteria are obtained. EDAS is a ranking model. EDAS ranks the alternatives based on positive and negative distances from the mean. The computation steps are detailed below.

Firstly, m alternatives and n criteria are determined. Next, assessments are collected from e experts. These assessments are transformed into Fermatean fuzzy numbers. Thus, the assessment matrix for k^{th} expert formed in Eq. (9) is created [30].

$$\tilde{A}^k = \left[\tilde{a}_{ij}^k\right]_{m\times n} \quad (9)$$

Afterwards, a decision matrix is constructed using Eq. (10) and Eq. (11):

$$\tilde{X} = \left[\tilde{x}_{ij}\right]_{m\times n} \quad (10)$$

$$\tilde{x}_{ij} = \frac{1}{e}\sum_{k=1}^{e}\tilde{a}_{ij}^k \quad (11)$$

Next, the normalized values are estimated with the help of Eq. (12) and Eq. (13):

$$r_{ij} = \frac{SF(\tilde{x}_{ij}) - \min_i SF(\tilde{x}_{ij})}{\max_i SF(\tilde{x}_{ij}) - \min_i SF(\tilde{x}_{ij})};\ for\ B \quad (12)$$

$$r_{ij} = \frac{\max_i SF(\tilde{x}_{ij}) - SF(\tilde{x}_{ij})}{\max_i SF(\tilde{x}_{ij}) - \min_i SF(\tilde{x}_{ij})};\ for\ C \quad (13)$$

where, B and C show the beneficial and cost criterion. SF is the score function defined in Eq. (7). Later, percentage values are computed via Eq. (14):

$$pv_j = \left|\ln\left(\frac{\sqrt{\frac{\sum_{i=1}^{m} r_{ij}^2}{m}}}{\sigma_j}\right)100\right| \quad (14)$$

where, σ is the standard deviation of the criteria. Then, the weights of the criteria are defined by Eq. (15):

$$w_j = \frac{pv_j}{\sum_{t=1}^{n} pv_t} \quad (15)$$

After defining the criteria weights, a normalized matrix is obtained with Eq. (16) and Eq. (17):

$$\tilde{h}_{ij} = \left(\mu_{\tilde{h}_{ij}}, \vartheta_{\tilde{h}_{ij}}\right) = \left(\mu_{\tilde{x}_{ij}}, \vartheta_{\tilde{x}_{ij}}\right);\ for\ B \quad (16)$$

$$\tilde{h}_{ij} = \left(\mu_{\tilde{h}_{ij}}, \vartheta_{\tilde{h}_{ij}}\right) = \left(\vartheta_{\tilde{x}_{ij}}, \mu_{\tilde{x}_{ij}}\right);\ for\ C \quad (17)$$

Afterwards, the average solutions are established using Eq. (18):

$$\widetilde{AV}_j = \left(\sqrt[3]{1 - \prod_{i=1}^{m}\left(1 - \mu_{\tilde{h}_{ij}}^3\right)^{\frac{1}{m}}}, \prod_{i=1}^{m}\vartheta_{\tilde{h}_{ij}}^{\frac{1}{m}}\right) \quad (18)$$

Next, the positive distance from average and the negative distance from average are calculated via Eq. (19) and Eq. (20), respectively.

$$PDA_{ij} = \frac{\max\left(0, SF(\tilde{h}_{ij}) - SF(\widetilde{AV}_j)\right)}{SF(\widetilde{AV}_j)} \quad (19)$$

$$NDA_{ij} = \frac{\max\left(0, SF(\widetilde{AV}_j) - SF(\tilde{h}_{ij})\right)}{SF(\widetilde{AV}_j)} \quad (20)$$

PDA and NDA are aggregated with the help of Eq. (21) and Eq. (22):

$$SP_i = \sum_{j=1}^{n} w_j PDA_{ij} \quad (21)$$

$$SN_i = \sum_{j=1}^{n} w_j NDA_{ij} \quad (22)$$

SP and SN are normalized using Eq. (23) and Eq. (24):

$$NSP_i = \frac{SP_i}{\max SP_i} \quad (23)$$

$$NSN_i = 1 - \frac{SN_i}{\max SN_i} \quad (24)$$

Finally, the final assessment values are defined by Eq. (25):

$$FA_i = \frac{NSP_i + NSN_i}{2} \quad (25)$$

IV. Analysis

This section relates to the results of the methodology described in the previous section.

A. Defining the Alternatives and Criteria

Six strategies are selected as alternatives. Similarly, the criteria are defined. The first criterion is financial resilience (CAR, NPL, profit stability). This criteria's short code is FNNR for analysis. The other strategies are financial resilience (CAR, NPL, profit stability) with ENVR, governance quality (ESG-G Scores) with GVRQ, audit reliability with AUDR, digitalization and innovation capability with DINC, and stakeholder engagement and social contribution with STSC. The strategies are shown in Table I.

TABLE I. Strategies List

Definition	Short Code
Sustainable financing policies that reduce credit risk	SFPRCR
Green investments that strengthen capital adequacy	GISCA
Improving corporate governance and transparency standards	ICGTS
Improving the quality of independent auditing and reporting	IQIAR
Expanding digital green banking practices	EDGBP
Stakeholder engagement and sustainable financial education programs	SESFEP

B. Weighting Criteria

After defining the strategies and criteria, assessments are collected from ten experts with linguistic scales in Table II.

TABLE II. LINGUISTIC SCALES

	Membership	Non-Membership
VE	.9	.2
E	.8	.3
ME	.7	.5
ME	.6	.6
MU	.5	.7
U	.3	.8
VU	.2	.9

Using linguistic scales, ten assessment matrices are obtained. These matrices have the form in Eq. (9). After that, the decision matrix is constructed using Eq. (10 and Eq. (11). The decision matrix is illustrated in Table III.

TABLE III. DECISION MATRIX

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
SFPRCR	(.468,.741)	(.517,.693)	(.552,.661)	(.576,.639)	(.468,.741)	(.498,.75)
GISCA	(.594,.637)	(.576,.67)	(.431,.757)	(.517,.701)	(.585,.653)	(.436,.77)
ICGTS	(.55,.669)	(.586,.616)	(.538,.707)	(.561,.652)	(.525,.692)	(.568,.648)
IQIAR	(.53,.675)	(.532,.668)	(.399,.78)	(.585,.653)	(.555,.653)	(.489,.716)
EDGBP	(.813,.31)	(.841,.297)	(.836,.283)	(.836,.313)	(.825,.297)	(.825,.326)
SESFEP	(.448,.78)	(.559,.66)	(.436,.76)	(.55,.669)	(.623,.602)	(.543,.71)

All criteria are beneficial. For this reason, Eq. (12) is used for estimating the normalized values. The normalized values are shared in Table IV.

TABLE IV. NORMALIZED VALUES

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
SFPRCR	.090	.000	.299	.180	.000	.084
GISCA	.377	.111	.059	.000	.269	.000
ICGTS	.283	.213	.220	.139	.141	.317
IQIAR	.254	.062	.000	.168	.235	.136
EDGBP	1.000	1.000	1.000	1.000	1.000	1.000
SESFEP	.000	.107	.058	.097	.392	.195

Later, percentage values are computed via Eq. (14). Then, the weights of criteria are defined by Eq. (15). The results are summarized in Table V.

TABLE V. PV AND WEIGHTS OF CRITERIA

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
PV	36.394	21.2768	24.6879	24.2172	37.9157	28.0615
W	.211	.123	.143	.140	.220	.163

According to weights of criteria in Table V, the most important criterion is digitalization and innovation capability with .220.

C. Ranking Strategies

Since all criteria are of the useful type, Eq. (16) is used. Therefore, the normalized matrix is the same as the decision matrix in Table III. Next, the average solutions are established using Eq. (18). The average solutions are displayed in Table VI.

TABLE VI. AVERAGE SOLUTIONS

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
AV	(.611,.61)	(.642,.578)	(.601,.624)	(.641,.585)	(.635,.583)	(.61,.629)

Next, the positive distance from average and negative distance from average are calculated via Eq. (19) and Eq. (20), respectively. The PDA matrix is expressed in Table VII.

TABLE VII. PDA

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
SFPRCR	.000	.000	.000	.000	.000	.000
GISCA	.000	.000	.000	.000	.000	.000
ICGTS	.000	.000	.000	.000	.000	.000
IQIAR	.000	.000	.000	.000	.000	.000
EDGBP	578.179	6.974	-22.225	7.646	8.147	-24.798
SESFEP	.000	.000	.000	.000	.000	.000

Similarly, the NDA matrix is presented in Table VIII.

TABLE VIII. NDA

	FNNR	ENVR	GVRQ	AUDR	DINC	STSC
SFPRCR	348.581	3.724	-3.548	2.091	6.207	-12.448
GISCA	56.974	2.533	-12.381	4.223	2.340	-15.875
ICGTS	151.927	1.447	-6.452	2.579	4.180	-2.993
IQIAR	182.393	3.056	-14.550	2.224	2.837	-1.336
EDGBP	.000	.000	.000	.000	.000	.000
SESFEP	44.770	2.576	-12.430	3.066	.586	-7.956

PDA and NDA are aggregated with the help of Eq. (21) and Eq. (22). SP and SN are normalized using Eq. (23) and Eq. (24). The results are summarized in Table IX.

TABLE IX. SP, SN, NSP, NSN

	SP	SN	NSP	NSN
SFPRCR	.000	73.105	.000	.195
GISCA	.000	9.083	.000	.900
ICGTS	.000	32.093	.000	.646
IQIAR	.000	36.019	.000	.603
EDGBP	118.457	.000	1.000	1.000
SESFEP	.000	90.769	.000	.000

Finally, the final assessment values are defined by Eq. (25). FA values are shown in Table X.

TABLE X. FA VALUES

	FA
SFPRCR	.097
GISCA	.450
ICGTS	.323
IQIAR	.302
EDGBP	1.000
SESFEP	.000

According to FA values in Table X, the most suitable alternative is expanding digital green banking practices with 1.

V. CONCLUSION

The aim of this study is to develop a holistic and analytical decision-making model for determining priority strategies for achieving sustainable growth in the banking sector. In this context, a novel LOPCOW–EDAS integration based on Fermatean fuzzy sets is proposed. The model analyzes the qualitative assessments obtained from 10 experts by converting them into Fermatean fuzzy numbers to more realistically represent uncertainty and differences in expert judgments. The findings reveal that the "dissemination of digital green banking practices" criterion is the most critical factor, while the "digitalization and innovation capability" strategy is the top priority alternative. This result demonstrates that digital transformation and environmental sustainability elements must be managed in an integrated manner to achieve sustainable growth targets. The study contributes to the literature both methodologically and practically. From a methodological perspective, it fills a significant gap in the literature by proposing the Fermatean fuzzy LOPCOW–EDAS integration, which has not been used before in prioritizing sustainable growth strategies. From a practical perspective, it presents a data-driven decision support framework that will enable banks to more rationally structure their sustainable growth policies.

However, the study has some theoretical and methodological limitations. While the criteria and strategies used in the model are theoretically based on literature and expert opinions, their validity across different countries, time periods, or regulatory frameworks may be limited. Furthermore, because the concept of sustainable growth is multidimensional, some social and institutional factors were not included in the model. Methodologically, the most significant limitation of the proposed model is the limited number of experts and the limited evaluation range; this may partially reduce the generalizability of the results. To address these limitations, future studies could collect data from a larger group of experts from different countries, implement dynamic weightings in the model using AI-based learning algorithms (e.g., ANFIS, GA, or deep learning), and test the model's robustness by comparing the results with different types of fuzzy logic (e.g., spherical or neutrosophic fuzzy sets). This could both increase decision accuracy and broaden the model's applicability to different sectors.

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