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Aligning ESG Ratings and SDGs in the MENA Region: Challenges and Insights Through a Fuzzy Delphi Multi-Criteria Approach

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Abstract
This research paper looks at the intricate interrelationships between environmental, social and governance issues and government debt levels in the Middle East and North Africa region. The paper examines the emergence of various approaches in shaping government debt levels as part of developing sustainable models for this area. The study highlights comprehending problems in relation to how Environment, Social and Governance and sustainable development goals assessments and public-sector indebtedness should be integrated. The aim of this study is to identify challenges that hinder a smooth integration of this system required for comprehensive credit assessment informed by global best practices. Delphi technique is used to outline key areas relating to environmentally sustainable development goals inclusion into sector sovereign credit rating with specific reference to environmental, social and corporate governance ratings. This analysis employs a fuzzy Delphi method to define these challenges in order to accommodate built-in uncertainty associated with each problem area and also obtain weights for them all. Furthermore, Fuzzy Best Worst Methodology has been applied in this study to classify these problems according to their degree of importance. By integrating objectives with resources into lending strategies, we already have an improved combined/contingent approach within our midst. Fuzzy method is therefore an integral part of its use to integrate vagueness and ambiguity of the decision maker's opinions.

Keywords- Fuzzy Delphi method, Sovereign credit, SDGS, MENA region.

1. Introduction

Currently, the Environment, Social and Governance (ESG), integrated with the sustainable development goals (SDGs), is one of the paramount paradigms that have brought a new dimension into the aspect of sovereign creditworthiness testing, particularly in areas such as the Middle East and North Africa (MENA) region with distinct economic and social features. This is so because the alignment presents an avenue for sustainable finance and development practices that can result in long-term stability. However, ESG ratings have been rather difficult to harmonize with SDG frameworks across the MENA region. This may be linked to the diversified nature of economic conditions, varying governance structures, and unique environmental vulnerabilities that characterize this region. These pressing issues make the need for a holistic and sustainable sovereign credit assessment model even more urgent in the context of MENA. In fact, these issues need to be addressed with a view to ensuring financial stability and promoting sustainable development within the region.

The paper by Choy et al. (2021), claims that an individual nation's ability to wield influence over global finance heavily hinges upon its sovereign credit rating since it touches on borrowing costs and reflects how well-off financially such a state is. This is an important process that fosters stability and growth of economies especially in the MENA region. The significance of ESG factors has been on the rise. With the increasing international laws for foreign investment, having good sovereign credit has an important role in the growth of the economy (Popa, 2019). MENA sovereigns continue to be supported by robust prices. According to Fitch Ratings report (2023), Brent crude oil will average USD80 per barrel, which will contribute to growth and stability. Due to persistently high oil prices, the projected Gulf Cooperation Council average remains solid at 3.5% in 2024, despite slower non-oil growth. Standard & Poor's Global (2019) rates seven of the 13 MENA sovereigns in the Better Business Bureau (BBB) rating classification or above. BBB is a method of credit rating used by agencies such as Fitch Group, Moody's to indicate credit worthiness of the sovereign entity. Despite the Gross Domestic Product weighted average being closer to BBB, the average sovereign rating in the MENA region has been trending downward toward BBB.

When considered collectively, ESG factors indicate a country's long-term sustainability and are significant categories of attributes influencing the government's credit profile from the standpoint of credit ratings. Although the assessment providers do not explicitly measure the extent to which these factors are considered when assigning credit ratings, ESG concerns are increasingly recognised as a part of a country's credit rating assessment process (Pineau et al., 2022). On the other hand, there is a vulnerability regarding how precisely to integrate ESG metrics into the credit rating structure, particularly in the MENA region (Yalta and Yalta, 2018). According to Göll et al. (2019), with the UN's emphasis on SDGs, ESG factors have gained more attention in the global context This model is used by companies around the world to promote and encourage a sustainable vision, but the situation is such not easy for the MENA context. The challenges in the MENA region pertain more to income inequality, high unemployment rates, standardization, availability of technological infrastructure, and various others that become very important while assessing the depth of sovereign credit with respect to SDG goals vis-à-vis ESG measures. Understanding how ESG factors impact sovereign credit will help in addressing the challenges to integrate SDGs in the same. The present research attempts to address the following research questions:

(i) How the ESG issues impact the sovereign credit rating of the MENA region?
The question shows the linkage between Environmental, Social, and Governance factors and the creditworthiness of countries within the MENA region. The relation can be understood to be important because it shows that sustainable practices and policies might have impacts on financial stability and credit ratings for these nations.

(ii) What are the challenges for integrating SDGs and ESG ratings for MENA sovereign credit assessment?

It is necessary to deal with this because combining the frameworks will give a more holistic rating that produces an appropriate outcome on the country's long-term financial and social sustainability.

(iii) How can we identify these challenges and prioritize them?
It deals with ways of detecting and ranking challenges relevant in integrating SDGs and ESG ratings into sovereign credit assessments. Prioritization of these challenges is very important for the strategizing and framing of ways to mitigate them effectively, so as to improve the reliability and utilities of the credit assessment.

The paper uses Fuzzy theory to capture the imprecision and ambiguity in the decision maker's opinion. The Fuzzy Delphi method is utilized to integrate this imprecise opinion of the decision-makers and get the shortlisted challenges (Bui et al., 2020). To determine the weight of shortlisted challenges Fuzzy Best Worst Method is applied. The method aims to integrate SDG goals and ESG factors into credit assessment procedures.

The rest of the paper is divided as follows: Section 2 gives the review of literature on sovereign credit ratings, credit ratings in the MENA area and the use of ESG in risk assessment. Section 3 elaborates the methodology and results in Section 4. Section 5 provides implications and the conclusion with limitations of the study are given in Section 6.

2. Literature Review

2.1 Basis on Sovereign Credit Rating

Recent research on the impact of law and order has considered attempts to alter the legal environment enclosing government lending. For example, the study by Almutairi (2023), gives insights into how the recent legislative changes at the EU level have affected credit rating agencies. This paper, therefore, aims at assessing how the new regulations and sanctions, establishment of regulatory authorities like ESMA, and the civil liability framework setting influence the behaviors of the CRAs. The paper empirically adds to the changing environment of credit rating practices and regulatory compliance in the European credit rating industry by examining the accuracy of credit ratings assigned to non-financial firms, and further investigating the differences in enforcement levels amongst E.U. member states. Specifically, Darwis et al. (2023) contributes to the literature on variables affecting sovereign credit ratings in peer nations, such as Indonesia. It estimates strong correlations of GDP per capita, government debt, and CDS with sovereign credit ratings and introduces a new variable of Credit Default Swap in measuring default risk. By providing insightful information on managing the relationship with rating agencies, this research may facilitate policymakers and investors in improving their respective countries' sovereign credit ratings. For example, Tran et al. (2021) emphasize the importance of strengthening universal screening due to the COVID-19 health crisis. The study found that rather than responding to an acute health problem, the rates respond to changes in the economic impact of the pandemic. The causal relationship between comparative government debt and economic growth is discussed by Cheikh et al. (2021), which emphasizes the importance of borrowing for long-term growth. Experts and decision-makers are still interested in the effects of government borrowing levels. Gratcheva et al. (2022) look at how sovereign credit rating evaluations are impacted by both sovereign and national wealth-specific ESG factors as well as opportunities and risks related to managing so-called stranded assets like fossil fuel resources. The impact of holdings of national debt on banks' credit risk is also examined in a study by Abinzano et al. (2022). Moreover, Hu et al. (2023) offer proof that the natural, social, and administration (ESG) parts play a significant part in further developing rating results and reflecting the rising assumptions for financial backers for practical venture choices. The article by Hamida (2023), examines the main reasons for the increased concern about sovereign default risk in several different countries. It reviews two main literatures: first, it analyzes

sovereign risk using sovereign credit default swaps (CDS) as metrics and alternative ratings; secondly, it examines national and international variables that affect sovereignty risk. After a comprehensive review of the existing literature, it is clear that sovereign debt statistics must take into account new information and changes in the global financial system The present study aims to investigate the impact of technological development, sustainability changes and geopolitical pressures have had on sovereign credit risk assessment.

2.2 Public Credit in the MENA Region

Assessing the level of public debt is important, especially in the MENA region, as it has a significant impact on investor behavior and financial stability. The evolution of government debt ratings is illustrated in an analytical study by Naili and Laharici (2022), which shows the changes in strategy over time and rating companies. Also considering the economic environment, the study used an analytical framework to show how the "economic policy paradigm of growth" changed as a result of the explosion of the public debt crisis in the MENA countries in the 1970s, eventually leading to a "national debt crisis". Furthermore, analyzes of the country's debt policy and dynamics such as changes in dividend and default history provide clues about the financial strength and weakness of the sector (El-Mousawi et al., 2023).

The degree of government obligation in the MENA is not entirely set in stone by a wide assortment of institutional, political and financial elements (Quero, 2023). Researchers like Matallah (2022), Bahn et al. (2021) and Tazar et al. (2022) inspected the significance of factors like Gross domestic product development, expansion, political solidness, solid government and outer shortcomings in the assessment of a nation's credit in a remarkable quality of the MENA locale and oil reliance, international struggles, segment elements and financial strategy. These attributes make it more challenging to evaluate credit risk in the district. Understanding these variables is significant for financial backers and strategy creators to explore the monetary scene of the MENA locale successfully.

Empirical data show that public debt in the MENA region is linked to market outcomes. By providing a comprehensive analysis of the frequency of oil market shocks and sovereign credit risk of major oil exporting countries, Naifar (2024) contributed to the literature. The study provided multidimensional insights into the relationship between oil prices and sovereign credit risks. The study highlighted the vulnerability of the United Arab Emirates as a major net receiver of such risks and identified Brazil, Mexico, and Saudi Arabia as key transmitters of credit risk volatility. The findings provided useful information for policymakers, investors, and researchers by highlighting the significance of comprehending how various kinds of oil shocks influence sovereign credit risk across various time horizons and quantiles. Yalta and Yalta (2018) study makes it clear that, despite the extensive literature on comparative sovereign debt in the Middle East and North Africa (MENA) region, however, it takes into account the specific impact of geopolitics internal conflicts and regional wars over debt levels There is a significant knowledge gap Understanding the complex interactions between geopolitical threats and sovereign credit supply is important for assessing MENA countries of financial stability carefully and successful risk management plans are developed (Soltani et al., 2021).

2.3 Use of ESG Factors in Credit Risk Assessment

As the world experiences sustainability challenges, investors are considering ESG factors when making decisions. Although ESG introduces a new risk framework, it is a strategic alternative that is likely to be profitable (Engle et al., 2021). ESG is highly desirable in finance and plays a major role in policy formulation, decision-making and risk management (Brogi et al., 2022). Sustainability is at the centre of the current changes in financial markets (Eccles and Klimenko, 2019). Dmuchowski et al. (2023), investigate how environmental and social governance influences corporate value. A multicentre study by

Iazzolino et al. (2023), uses the Data Envelopment analysis, which is widely used in empirical economic research. The study concluded that businesses are more or less sensitive to the impact of ESG factors on business efficiency depending on the industry. A study by Pineau et al. (2022), elaborates on what ESG factors mean for sovereign obligation levels in the Middle East and North Africa locale. The impact of ESG components on bank stock returns in the MENA region is considered in the Mallek et al. (2024) study. There is little research that focuses on the precise relationship between ESG factors and sovereign credit ratings in MENA nations (El-Khoury et al., 2023). Exploring the challenges to which ESG influences credit ratings could provide valuable insights for both policymakers and investors seeking to integrate ESG considerations into their risk assessments, which is the motivation behind the present study. The recent research by Meng and Shaikh (2023), examines and prioritizes ESG factors and investment strategies for green finance development, acknowledging the complexity of ESG criteria. The paper used multi-criteria decision-making tools of fuzzy AHP and WASPAS methods. The paper concluded that key investment strategies identified include green bonds, ESG integration, and renewable energy funds, emphasizing the necessity of integrating ESG criteria into green finance approaches. It can be observed that by understanding the major challenges researchers can contribute to a better understanding of the sovereign creditworthiness and its impact on global financial stability and sustainable development. Part of this is to understand the very first challenge in sovereign credit risk assessment in ESG for the MENA sector, which in fact is the research question of the present study.

2.4 Implementation of SDGs in MENA Region

The SDGs are a global agenda that aims to end some of the most intractable social, economic, and environmental challenges faced by humanity by 2030. The MENA region is a distinctive development dynamic, informed by diverse socio-economic contexts, political instabilities, and environmental vulnerabilities. In an all-inclusive review of national progress in realizing the SDGs, the paper by Allen et al. (2018) added significant value to the scholarship in sustainable development studies. Because this document combines multiple sources of information—including scholarly writing and government publications—that cover the status of global SDG implementation, it is possible to identify areas that have progressed and others that require more work. Common themes and gaps identified by the study inform a comprehensive understanding of the complexity involved. Their findings add valuable information to stakeholders and governments to improve the outcome of SDG achievements and, therefore, contribute to furthering the present global efforts in promoting sustainable development goals. Kassouri and Altıntaş (2020), embark on research aimed at analyzing the trade-off between human well-being and environmental issues. The paper concluded that there was indeed a strong trade-off between the ecological footprint and human well-being captured by the human development index. A paper by Hassen and EI-Bilali (2024), discusses measures taken by the MENA countries to integrate the SDGs into their national development policies and strategies. In another study, Awijen et al. (2022), evaluate the drivers of renewable energy deployment in the MENA countries, considering a range of economic, financial, and political variables that include financial development, government effectiveness, and political stability. Dhaoui (2022) evaluates the role of e-government in good governance on sustainable development, i.e., the digital dividends in the MENA region. The results reveal that good governance has a positive contribution to sustainable development. It is concluded that digitalization improves control of corruption and government effectiveness, and to a lesser extent, regulatory quality. Khalfaoui et al. (2023) examine the impact of corruption on environmental quality in 17 Middle East and North Africa (MENA) countries from 1984 to 2018, using four environmental degradation indicators. Applying the method of moments quantile regression reveals that corruption exacerbates environmental degradation, with varying severity across different levels of degradation. The findings underscore the necessity of tackling corruption to enforce stricter environmental regulations effectively. Nevertheless, despite this literature, the MENA region continues to face particular difficulties in coordinating SDG objectives with ESG measures in the context

of sovereign credit evaluation, which has not been highlighted in the extant literature. This study aims to bridge this gap by exploring how ESG considerations influence sovereign credit assessments in the MENA region. The sustainability challenges in the MENA region and their impact on global trade-offs in resources are not well understood or addressed. The MENA region is vulnerable in terms of meeting future water requirements, especially in Gulf states with high per capita incomes. MENA states experience economic growth, urbanization, demographic and lifestyle changes. These changes affect the environment and sustainability.

Socio-economic variables and demographics in the middle East and North Africa impact sustainability. Urbanization is a major factor driving growth, with a high rate of 2.5 times the global average. It is predicted that the urban population will rise from 100 million to 250 million in the next two decades, generating 70% of future jobs. The sustainability challenge in the Middle East and North Africa is linked to development. Development has been traditionally connected to social change and modernization. Modernization has been deemed slow or painful. Gulf oil-producing countries have developed rapidly, skipping traditional development phases. Factors affecting policy-making in the MENA region are related to societal models. Arab society is traditionally based on tribal affiliations and patronage welfare. Post-independence, the drive for fast modernization surpassed political systems' capacity. All countries were influenced by traditional mentalities and a desire for international interaction and transparency. Modernization efforts follow Western models and ruling elites' perceptions. The policy is viewed through international relations, defense of sovereignty is crucial. Globalization, international institutions, and own governance force the adoption of paradoxical policies, leading to instability in sustainability. MENA decision-makers have to weigh opportunity costs against compromises. The usage of fossil fuels creates detrimental externalities and reduces environmental sustainability, which will cost funds in the future. The transition to diverse and sustainable growth Benmamoun et al. (2017) is necessary for decision-makers to provide ongoing income for future generations. This entails making infrastructural and human capital investments as well as lowering dependency on oil. Because of the intrinsic links between the environment and the economy, sustainability issues have long-term financial consequences. Policies that look forward are necessary to prevent burdening future generations.

2.5 Instances of Effective ESG-SDG Alignment Programs in Other Areas

The Sustainable Stock Exchanges (SSE) Initiative seeks to promote sustainability performance and transparency across stock exchanges worldwide to achieve global ESG-SDG alignment. United Nations Global Compact (UNGC): The UNGC encourages collaboration between the public and private sectors by pressuring businesses to adopt sustainable practices and respect sustainable development principles (Podrecca et al., 2022). Dutch Coalition for Sustainable Growth (DSGC): The DSGC was founded in 2012 and is made up of Dutch multinational companies such as Unilever, Philips and AkzoNobel seek to promote environmental, social and economic growth through Sustainable Development Goals (SDGs) inclusion on performance measures (Bauer et al., 2021).

2.6 Gap in Literature

The assessment of the sustainability performance of companies in the Middle East and North Africa (MENA) region has relied heavily on the implementation of environmental and social governance (ESG) ratings in the years in the past (Khaled et al., 2021). Investors and stakeholders are becoming increasingly critical of corporate ESG strategies as social responsibility and climate change become more accepted issues. Highlighting the importance of strong governance to balance the social, environmental and economic aspects of sustainable development, Omri and Mabrook (2020), conducted a study made before sustainable development. Their study of 20 MENA economies between 1996 and 2014 showed that institutional and political governance had a positive impact on factors for sustainable development,

suggesting a link between economic growth and human development. From 1971 to 2016, Taghvaee et al. (2022), examined how openness and globalization affect sustainable development in North America and the MENA region. Positive sustainability elasticities were found in sectors using the SEY model including Granger Causality, Vector Auto Regressive (VAR), and Simultaneous Equations System methods. This suggests that synergistic sustainability extends benefits rather than trade-offs. The report endorsed regional openness and cooperation in line with the UN SDGs. Abdullah and Jawad (2024), added to the body of knowledge by investigating how climate risk affects the relationship between ESG levels and business performance in the MENA region from 2006 to 2021. According to their research, there are mixed effects ESG scores had a positive impact on market performance but a negative impact on operational and financial success. Impacts vary across countries with varying levels of climate risk, and the study examined the fit of the Environmental Performance Index and net-zero policies to this relationship.

However, there is still a clear lack of research on ESG ratings in the MENA region. While some studies emphasize the adoption of ESG concepts, others emphasize barriers including data availability and openness. Furthermore, the need for sustainability frameworks and UN SDGs to effectively address local issues is increasingly evident. There are prospects and challenges related to the integration of ESG multiples and SDGs for the MENA region. Companies can improve their development strategies and support regional development goals by integrating the SDGs into their ESG strategy (Al-Jayyousi et al., 2023). However, the MENA region has particular challenges in integrating the SDG goals with ESG indicators in the assessment of sovereign credit—an issue that has not yet received much attention in the literature. This study takes a gander at what ESG issues mean for sovereign obligation levels in the MENA locale trying to address this gap. For the methodology, very few studies such as Petrudi et al. (2022) and Rejeb et al. (2022) have applied similar method in the sector of higher education and circular economy.

3. Methodology

3.1 Identification of the Experts and Interview

Initially, the questionnaire was mailed to 50 industry experts, out of these only 15 experts replied about their interest and availability for the data collection process Kaššaj and Peráček (2024).

The set included experts from officials from the central and local banks, Ministries of Finance or Economics and heads of economic research departments. In-depth analyses of market movements, economic indicators, and prospective hazards were provided by financial analysts and economists, who were also recognized for their competence. Furthermore, using a panoply of data and analytical frameworks, international rating agencies Standard & poor's, Moody’s and Fitch ratings, provide impartial assessments of a country's creditworthiness. To contribute to their insightful academic assessments and experiential research findings and to integrate nuanced perspectives into the conversation, academics and researchers in this field were also contacted. Consulting firms, such as McKinsey & Company and Deloitte, offer strategic guidance and advisory services, leveraging their extensive experience in economic analysis and risk assessment. Regional economic organizations, including the Arab Monetary Fund and the Gulf Cooperation Council (GCC), provide a broader regional context, highlighting interdependencies and shared challenges among member countries. Out of them, 10 experts were selected for this study as 5 were not apt for the study due to recurring values. All these experts have extensive experience of at least 10 years in the MENA region, conducting ESG assessment, Sustainable development, as well as sovereign credit rating. The participating experts were chosen based on their current roles as senior analysts or managers for some of the biggest financial institutions, academics and researchers for prominent universities, and senior consultants for ESG. Such selection was aimed at avoiding bias that may be associated with sources of information and at the same time ensuring that the information was obtained from experts in the particular fields of interest. To involve and prioritize the expert opinions we used Fuzzy Delphi and Fuzzy BWM methods, which helped to account

for the mentioned uncertainty and disparities in the experts' knowledge levels. The selection criteria emphasized not only the depth of knowledge and track record of contributions but also the diversity of perspectives and representation across different sectors and geographic locations within the MENA region. We have tried to make sure that different segments of the MENA region are covered, however, due to confidentiality factors we cannot disclose the exact names and positions of the experts. To verify expertise, thorough reviews of professional credentials and past contributions were conducted. Throughout the study, panellists were actively engaged through various means, including surveys and meetings, to solicit their insights and feedback. Confidentiality measures were implemented to ensure the integrity of discussions, and mechanisms were in place to manage potential conflicts of interest.

These experts are then asked to evaluate the challenges and rate them based on their personal experience and judgment regarding the level of prominence of each challenge. A 30-minute session was conducted with each expert. The questionnaire is given in Appendix 1. Once the data is collected, we check the data for any missing value or redundancy. If any value is missing, we go back to the expert and get the required information. Once we are satisfied with the data we use MS-Excel to carry out the Fuzzy Delphi method. The modern industry has become a data churner that collects and evaluates data to satisfy its needs to ensure revenue and generate better profits in the long run. To understand the challenges and strategies that must be adopted to overcome the sovereign credit risks and ESG for integrating sustainability the current study adopts a multi-criteria approach, wherein challenges are shortlisted based on their weights derived from the Fuzzy Delphi methodology It was challenging to obtain precise and deterministic data from the stakeholders, instead, data obtained was vague, incomplete, or subject to ambiguity. The Fuzzy Delphi method is used to manage this uncertainty by allowing authors to work with fuzzy or imprecise information. The shortlisted challenges are prioritized using Fuzzy BWM to generate weights.

3.2 Fuzzy Delphi Method

In this section, the Fuzzy Delphi Method is used. The study by Ishikawa et al. (1993) provides insights into combining Fuzzy Set Theory with Delphi Methodology, to further enhance the decision-making process (process given in **Figure 1**).

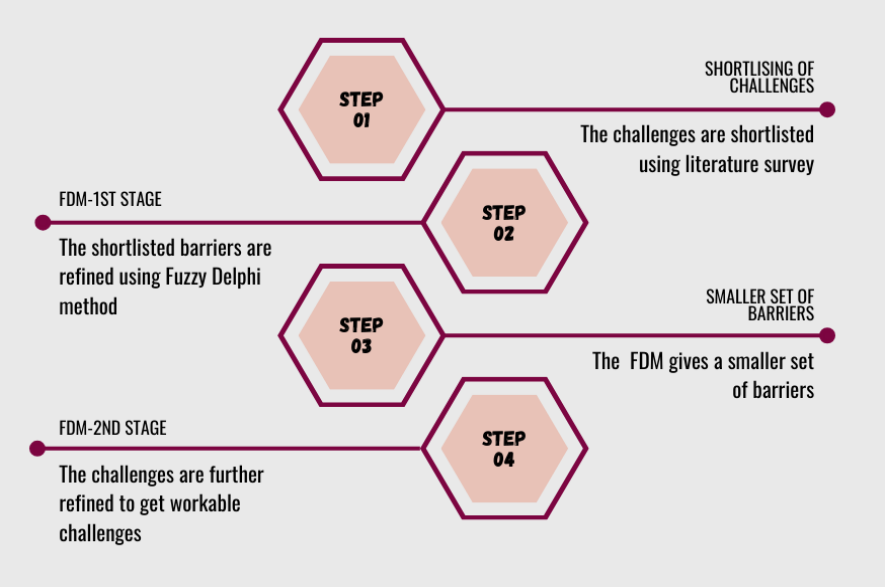

Figure 1. Flow chart of the process.

Fuzzy theory has several benefits as it aims to provide a solution in case of imprecise and inadequate data which when combined with Delphi methodology, will further make our process more decision-maker friendly (Bui et al., 2020). When compared to other MCDM methods, the Delphi approach is easy to understand, more friendly towards decision-makers and cost-effective. The paper by Adler and Ziglio (1996) suggested that a minimum of 10 experts are needed to gain consistency for the Fuzzy Delhi approach. The Fuzzy Delphi method was selected for this research based on its capability in managing the vagueness and ambiguity when both SDGs and ESG metrics are incorporated into sovereign credit risk analysis. This method integrates the Delphi method's iterative survey approach with fuzzy logic since it admits the incorporation and weighting of the opening of the experts. It is in this context that one may integrate the imprecision and ambiguity through the use of fuzzy logic in quantifying qualitative judgments. Using experts, the Delphi technique also repeats the process continuously, allowing great accuracy and effectiveness in the results obtained. In addition, a more precise view of the challenges can be obtained using the Fuzzy Delphi method by evaluating degrees of uncertainty in the experts' opinions and applying the method as an effective tool for correctly outlining and ranking the challenges in alignment of ESG ratings with SDGs. This approach facilitates the consideration of multiple sources of information and skill levels of the experts, thus yielding more inclusive and unbiased results.

Step 1: Questions such as "How important is ***Challenge* 1** in sustainable sovereign credit in the MENA region?" are asked of the respondents and the responses are collected in terms of linguistic terms. Similar types of questions are asked for all the shortlisted challenges (see **Table A1**).

Step 2: The inputs of the experts are used to understand the importance of challenges. Mathematically, the significance of attribute b is assessed by expert a as $j = (x_{ab}; y_{ab}; z_{ab})$, a= 1,2, 3,….n; b=1,2,3….m; then, the weight j_b of element b is j_b= $(x_b; y_{b;} z_b)$ where $x_b = (x_{ab}),\ y_b = (\Pi_1^n y_{ab})^{1n}$, and $z_b = (\ z_{ab})$.

Step 3: The inputs of the experts are changes in corresponding triangular fuzzy number (TFN) using **Table 1** (adopted from Bui et al., 2020).

Table 1. Fuzzy linguistic scale.

Linguistic terms	Corresponding TFNs
Strong Prominence	(0.75, 1.0, 1.0)
High Prominence	(0.5, 0.75, 1.0)
Neutral	(0.25, 0.5, 0.75)
Low Prominence	(0,0.25,0.5)
No Prominence	(0,0,0.25)

Step 4: The next step is to generate the convex combination value, D_d, using the following equations (Wu et al., 2018).

$$u_b = z_b - \alpha(z_b - y_b), l_b = x_b - \alpha(\ y_b - yx_b), b = 1,2,3 \ldots . m \quad (1)$$

Step 5: Normally a value of 0.5 is used, however, this can vary from 0 to 1 based on whether the experts are positive or negative perceivers. The precise value of D_d can be calculated as follows:

$$D_d = \int (u_b, l_b) = \delta[\ u_b + (1 - \delta) l_b] \quad (2)$$

where, δ is utilized to describe the positivity level of a decision maker and to establish equilibrium across the fundamental judgements among the expert group.

Step 6: Then, $\gamma = \Sigma_{a=1}^{n}(D_d/n)$ is the threshold to identify the important challenges. If $D^d \geq \gamma$challenge b is accepted. Otherwise, it is rejected.

To Prioritize These Challenges (Using* FBWM*)

In this section, the detailed steps of fuzzy BWM are given:

Step 1: Build the decision criteria system.

The decision criteria system consists of a set of decision criteria on which analysis is to be made.

Step 2: Determine the best (most crucial) and the worst (least crucial) challenges.

The most and the least crucial challenges are identified based on the opinion of the decision-makers. The most crucial challenge is represented as C_B, and the worst challenge is labelled as C_W.

Step 3: Execute the fuzzy reference comparisons with respect to the most crucial challenge.

Linguistic terms are used to get the preferences of the most important challenge over the other challenges. Then, the obtained fuzzy preferences are transformed into Triangular Fuzzy Numbers (TFNs) according to the transformation rules. The obtained fuzzy Best-to-Others vector is:

$$\tilde{A}_B = (\tilde{a}_{B1}, \tilde{a}_{B2},\ldots, \tilde{a}_{Bn}).$$

where, $\tilde{A}_B$ shows the fuzzy Best-to-Others vector; $\tilde{a}_{Bj}$ represents the fuzzy preference of the most crucial challenge C_B over challenge j, j = 1, 2…, n. It can be known that $\tilde{a}_{BB} = (1, 1, 1)$.

Step 4: Determine the fuzzy reference comparisons for the least crucial challenge.

In this step, we compute the fuzzy preferences of all the challenges over the least crucial challenge. The fuzzy Others-to-Worst vector can be obtained as:

$$\tilde{A}_W = (\tilde{a}_{1W}, \tilde{a}_{2W},\ldots, \tilde{a}_{nW})$$

where, $\tilde{A}_W$ shows the fuzzy Others-to-Worst vector; $\tilde{a}_{iW}$ represents the fuzzy preference of challenge i over the least crucial challenge C_W, i = 1, 2..., n. It can be known that $\tilde{a}_{WW} = (1, 1, 1)$.

Step 5: Determine the optimal fuzzy weights.

We find the optimal solution for the two vectors using the steps given in Appendix 2.

Step 6: Evaluate the consistency of the solution.

The closer the consistency ratio is to zero value, the more consistent the responses of the decision makers. We check the consistency of the using the following formula:

$$\text{Consistency Ratio} = \frac{\phi^*}{\text{Consistency Index}} .$$

Table 2 shows the consistency index.

Table 2. Consistency index.

n	1	2	3	4	5	6	7	8	9
Consistency index (max)	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

The value of consistency ratio closer to '0' shows more consistency while values closer to 1 show less consistency.

Step 7: Computation of crisp weight.

Once we calculate the fuzzy weights, we then find the crisp weights of the challenges using graded mean

integration representation (GMIR)of a TFN $a_i = (li, mi, ui)$. The following mathematical formula is used to calculate the GMIR.

$$R(a_i) = \frac{l_i + 4m_i + u_i}{6}.$$

4. Proposed Analytical Procedure

This research is but an attempt to quantify decision makers' perception of key challenges that ESG concerns and sovereign credit assessment mainly face in the MENA region under the application of FDM. The methodology shall be conducted in two phases: theoretical assessment, of the proposed challenges, from literature and experts probing for said challenges; and second, online and face-to-face interviews to assess experts' knowledge and reliability. In the second stage of this study, a 2-round FDM will be conducted for the purpose of filtering out unnecessary challenges and ranking them in order of importance. The evaluation process is shown as follows:

(i) The probable attributes of challenges are collected from the literature. The finalization of the proposed attributes takes place with experts through a group discussion.

(ii) Round 1 FDM is used in order to tune the key challenges using Equations (1) and (2). The prepared questionnaire is given to experts to fill in an additional evaluation with respect to the suggested challenges.

(iii) Round 2 FDM assessment is carried out for enhancing the reliability and precision of measurement. The outcome of round 1 is used again to regenerate the questionnaire and take the expert's judgment about the best performing evaluation. The system repeats the FDM process to generate the final set of challenges. The crucial challenges are checked so that it provides accurate implications for development in ESG concerns and sovereignty credit assessment in the MENA region.

(iv) Using Fuzzy BWM, after shortlisting, the challenges involved are prioritized to know the weights or level of importance of each challenge.

4.1 Phase I – Identification of Challenges

Initially, the challenges are identified from the extant literature review as listed in **Table 3**.

Table 3. Initial set of challenges.

Notation	Challenge	Description	Reference
MCH1	Data Availability	The limited availability of reliable data on ESG factors and SDG indicators in the MENA region hampers accurate assessment.	Guerra and Leite (2021)
MCH2	Data Quality	Existing data may lack consistency, completeness, and reliability, making it challenging to derive meaningful ESG ratings aligned with SDGs.	Kotsantonis and Serafeim (2019)
MCH3	Standardization	The lack of standardized frameworks for ESG assessment and SDG alignment complicates harmonization efforts.	Kotsantonis and Serafeim (2019)
MCH4	Contextual Relevance	ESG criteria and SDG indicators may not adequately reflect the region's unique economic, social, and environmental challenges.	Chopra et al. (2024)
MCH5	Cultural Sensitivity	Cultural differences across MENA countries may influence the interpretation and prioritization of ESG factors and SDGs.	Shin et al. (2023)
MCH6	Regulatory Environment	Inconsistent or vague regulatory frameworks related to ESG reporting and SDG implementation hinder alignment efforts.	Yébenes (2024)
MCH7	Political Instability	Geopolitical tensions and regime changes in the region introduce uncertainty, affecting long-term sustainability strategies aligned with SDGs.	Elidrisy (2024)
MCH8	Resource Constraints	Limited financial and human resources impede the capacity to collect, analyze, and report ESG data and SDG progress.	Yébenes (2024)
MCH9	Technological Infrastructure	Inadequate technology infrastructure restricts access to digital tools necessary for ESG data collection, analysis, and reporting.	Lee and Kim (2022)
MCH10	Capacity Building	Insufficient expertise and skills in ESG analysis and SDG implementation among businesses, governments, and civil society hamper harmonization efforts.	Litvinenko et al. (2022)

Table 3 continued…

MCH11	Language Barriers	The diversity of languages spoken across the MENA region complicates communication and collaboration on ESG and SDG initiatives.	Al-Issa (2017) Wu et al. (2018)
MCH12	Stakeholder Engagement	Limited stakeholder engagement and consultation impede the inclusivity and effectiveness of ESG and SDG integration processes.	Rau and Yu (2024)
MCH13	Data Privacy	Concerns about data privacy and security hinder the sharing and transparency of ESG-related information, impacting SDG reporting.	Kotsantonis and Serafeim (2019)
MCH14	Greenwashing	Lack of clear criteria for assessing genuine ESG performance increases the risk of greenwashing, undermining SDG alignment efforts.	Free et al. (2024)
MCH15	Fragmentation	Fragmented ESG reporting standards and SDG monitoring mechanisms across MENA countries create challenges for comparability and benchmarking.	Chopra et al. (2024)
MCH16	Access to Finance	Limited access to sustainable finance options constrains investments in projects aligned with ESG principles and SDGs.	Chausson et al. (2023)
MCH17	Institutional Capacity	Weak institutional structures and governance frameworks hinder the effective coordination of ESG and SDG initiatives at national and regional levels. (World Bank, 2021)	Singhania and Saini (2023)
MCH18	Conflict Zones	The presence of conflict zones in the MENA region disrupts development efforts and exacerbates socio-economic inequalities, impeding progress towards SDGs.	Hazbun (2018)
MCH19	Climate Vulnerability	MENA countries are particularly vulnerable to climate change impacts, complicating efforts to achieve climate-related SDGs.	Solomon and Tausch (2021)
MCH20	Water Scarcity	It is a pressing issue in the MENA region, requiring integrated approaches to water management for SDG fulfilment.	Weinthal and Sowers (2020)
MCH21	Energy Transition	Transitioning towards renewable energy sources faces challenges due to entrenched fossil fuel dependence and infrastructural limitations.	Razi and Dincer (2022), Eitan and Hekkert (2023)
MCH22	Youth Unemployment	High rates of youth unemployment in the region necessitate targeted interventions for sustainable economic growth and decent work	Arezki et al. (2018)
MCH23	Gender Inequality	Persistent gender disparities in the MENA region require gender-sensitive policies and initiatives to advance gender equality and women's empowerment	Ryan (2022)
MCH24	Education Quality	Disparities in education quality and access hinder progress towards SDG 4 (Quality Education) and socio-economic development	Thorpe et al. (2010)
MCH25	Urbanization Challenges	Rapid urbanization in the MENA region brings about infrastructure strain, resource depletion, and social inequalities, posing obstacles to sustainable development. Coastal cities have the risk of falling into the sea due to rising sea levels, drying up of water bodies and experiences of annual floods.	Solomon and Tausch (2021)
MCH26	Biodiversity Loss	MENA's unique ecosystems face threats from urbanization, overexploitation, and climate change, necessitating biodiversity conservation efforts.	Malli et al. (2023)
MCH27	Healthcare Infrastructure	Inadequate healthcare infrastructure and access to essential services undermine efforts to achieve health-related SDGs.	Katoue et al. (2022)
MCH28	Corruption	Corruption and lack of transparency impede effective governance and hinder progress towards sustainable development goals.	Farah et al. (2021)
MCH29	Migration Challenges	MENA's complex migration dynamics require inclusive policies and regional cooperation to address displacement, labor mobility, and refugee integration.	Mingot (2012), Marchetta (2012)
MCH30	Food Insecurity	Persistent food insecurity in the region demands sustainable agricultural practices, resilient supply chains, and social protection mechanisms.	Wahbeh et al. (2022)
MCH31	Land Degradation	Land degradation threatens agricultural productivity, biodiversity, and ecosystem services, necessitating land restoration efforts.	Devkota et al. (2022)
MCH32	Natural Disasters	MENA countries are prone to natural disasters such as droughts, floods, and earthquakes, necessitating preparedness and resilience-building measures.	El-Kholei (2019)
MCH33	Infrastructure Deficit	Inadequate infrastructure in transportation, energy, and sanitation hampers socio-economic development and SDG attainment.	Rayan, and Djebedjian (2016), Choueiri et al. (2013)
MCH34	Youth Radicalization	Socio-economic marginalization and lack of opportunities contribute to youth radicalization, posing security challenges and hindering sustainable development.	Djebbi (2022)
MCH35	Digital Divide	Disparities in digital connectivity and access to technology exacerbate inequalities and limit opportunities for inclusive development.	Arezki et al. (2018)

Table 3 continued…

MCH36	Labor Rights	Ensuring labor rights and decent work conditions is crucial for sustainable development, yet enforcement mechanisms may be weak or lacking.	Abaunza (2022)
MCH37	Cultural Heritage Preservation	The preservation of cultural heritage sites is essential for identity preservation and tourism development but may face threats from urbanization and conflict.	El Shafaki et al. (2024), Djebbi (2022)
MCH38	Economic Diversification	Over-dependence on oil and gas revenues in some MENA countries necessitates efforts towards economic diversification for sustainable development.	Aljuwaiber (2021)
MCH39	Access to Clean Water	Limited access to clean water and sanitation services poses health risks and impedes progress towards SDG 6 (Water and Sanitation).	Haddaoui and Mateo-Sagasta (2021)
MCH40	Lack of Natural Resource Management	There is a need to conserve the environment including minerals and fisheries.	Ali and Chouaibi (2023)
MCH41	Waste management system	Rapid urbanization is leading to the pressure on the infrastructure for integrating sustainable waste management system	Solomon and Tausch (2021)

4.2 Phase II – Using Fuzzy Delphi Method-Screening of Challenges

In Phase I, the initial set of challenges are evaluated by sharing the questionnaire with experts, requesting them to rate the challenges based on the level of prominence of the Sovereign credit rating and ESG based on their personal experience and judgment. After this evaluation, the linguistic terms were converted into corresponding triangular fuzzy numbers. The FDM is applied to refine the important challenges, which are obtained in **Table 4** with the threshold $\gamma = 0.319$.

Table 4. Phase I- challenges screening out.

Notation	Upper value (U_b)	Lower value (l_b)	Convex combination value (D_b)	Decision
MCH1	0.375	0.000	0.188	Reject
MCH2	0.500	0.000	0.250	Reject
MCH3	0.959	0.291	0.552	Accept
MCH4	0.909	0.341	0.540	Accept
MCH5	0.718	-0.218	0.304	Reject
MCH6	0.375	0.000	0.188	Reject
MCH7	0.815	0.060	0.423	Accept
MCH8	0.375	0.000	0.188	Reject
MCH9	0.838	0.037	0.428	Accept
MCH10	0.500	0.000	0.250	Reject
MCH11	0.852	0.023	0.432	Accept
MCH12	0.500	0.000	0.250	Reject
MCH13	0.250	0.000	0.125	Reject
MCH14	0.935	-0.435	0.359	Accept
MCH15	0.500	0.000	0.250	Reject
MCH16	0.815	-0.315	0.329	Accept
MCH17	0.959	0.291	0.552	Accept
MCH18	0.500	0.000	0.250	Reject
MCH19	0.838	0.037	0.428	Accept
MCH20	0.375	0.000	0.188	Reject
MCH21	0.500	0.000	0.250	Reject
MCH22	0.768	-0.268	0.317	Reject
MCH23	0.928	-0.053	0.451	Accept
MCH24	0.838	0.037	0.428	Accept
MCH25	0.873	0.002	0.437	Accept
MCH26	0.250	0.000	0.125	Reject
MCH27	0.856	-0.356	0.339	Accept
MCH28	0.500	0.000	0.250	Reject
MCH29	0.806	0.069	0.420	Accept
MCH30	0.375	0.000	0.188	Reject
MCH31	0.921	0.329	0.543	Accept
MCH32	0.500	0.000	0.250	Reject

Table 4 continued…

MCH33	0.803	0.072	0.419	Accept
MCH34	0.500	0.000	0.250	Reject
MCH35	0.540	-0.165	0.229	Reject
MCH36	0.815	0.060	0.423	Accept
MCH37	0.500	0.000	0.250	Reject
MCH38	0.552	-0.177	0.232	Reject
MCH39	0.763	-0.263	0.316	Reject
MCH40	0.500	0.000	0.250	Reject
MCH41	0.500	0.000	0.250	Reject

17 challenge barriers are accepted and subsequently renamed, as shown in **Table 5**.

Table 5. Phase I accepted barriers and renames.

Initial Set	Rename	Challenge
MCH3	ME1	Standardization
MCH4	ME2	Contextual Relevance
MCH7	ME3	Political Instability
MCH9	ME4	Technological Infrastructure
MCH11	ME5	Language Barriers
MCH14	ME6	Greenwashing
MCH16	ME7	Access to Finance
MCH17	ME8	Institutional Capacity
MCH19	ME9	Climate Vulnerability
MCH23	ME10	Gender Inequality
MCH24	ME11	Education Quality
MCH25	ME12	Urbanization Challenges
MCH27	ME13	Healthcare Infrastructure
MCH29	ME14	Migration Challenges
MCH31	ME15	Land Degradation
MCH33	ME16	Infrastructure Deficit
MCH36	ME17	Labor Rights

4.3 Phase III – Using the Second Round of Fuzzy Delphi Method- Shortlisting of Challenges

The accepted challenges are used as input for Phase II. Then again with these challenges, a questionnaire was made to find out the prominent challenges and a second phase of iteration was undertaken to reduce the number of barriers for focusing on the selected few challenges as the starting point. Further, it is shared with the experts for their input regarding the prominence levels of each challenge. The accepted challenges along with the ranking are presented in **Table 6**, where 10 challenges were accepted.

After a proper analysis, we found that 10 challenges have been accepted based on Db closeness to the threshold value of 0.388. These shortlisted challenges are further categorized into governmental and organizational challenges based on inputs from the decision-makers and academicians to make them workable for the next stage given in **Table 7**.

The results obtained by using Fuzzy Delphi are limited to the current study and our selection of decision-makers. Since, the subjective judgments of experts are the basis of the Fuzzy Delphi approach, which could skew the results for each study. The experts chosen for the Delphi panel have a big say in the outcome. Hence, during the initial discussion, we discussed with the experts and came to a consensus regarding the research questions that need to be addressed during this study. We can say that if the data set or the experts change there may be a variation of the results, which is the limitation of the study.

Table 6. Phase II- barriers accepted.

Notation	Challenge	u_b	l_b	D_b	Decision
ME1	Standardization	0.959	0.291	0.552	Accept
ME2	Contextual Relevance	0.500	0.000	0.250	Reject
ME3	Political Instability	0.959	0.291	0.552	Accept
ME4	Technological Infrastructure	0.928	-0.053	0.451	Accept
ME5	Language Barriers	0.250	0.000	0.125	Reject
ME6	Greenwashing	0.897	0.353	0.537	Accept
ME7	Access to Finance	0.852	0.023	0.432	Accept
ME8	Institutional Capacity	0.959	0.291	0.552	Accept
ME9	Climate Vulnerability	0.375	0.000	0.188	Reject
ME10	Gender Inequality	0.959	0.291	0.552	Accept
ME11	Education Quality	0.881	-0.006	0.439	Accept
ME12	Urbanization Challenges	0.500	0.000	0.250	Reject
ME13	Healthcare Infrastructure	0.250	0.000	0.125	Reject
ME14	Migration Challenges	0.921	0.329	0.543	Accept
ME15	Land Degradation	0.500	0.000	0.250	Reject
ME16	Infrastructure Deficit	0.959	0.291	0.552	Accept
ME17	Labor Rights	0.500	0.000	0.250	Reject

Table 7. Categorization of challenges.

Notation	Challenge	Categorization
ME1	Standardization	Government Challenge
ME3	Political Instability	Government Challenge
ME4	Technological Infrastructure	Organizational Challenge
ME6	Greenwashing	Government Challenge
ME7	Access to Finance	Organizational Challenge
ME8	Institutional Capacity	Organizational Challenge
ME10	Gender Inequality	Organizational Challenge
ME11	Education Quality	Government Challenge
ME14	Migration Challenges	Government Challenge
ME16	Infrastructure Deficit	Organizational Challenge

4.4 Phase IV – Using Fuzzy BWM-Priortization of Challenges

After further analysis, we ranked the challenges and concluded with the following most prominent challenge. **Tables A2** and **A3** give an initial pairwise comparison of governmental and organizational challenges. Using the steps of Fuzzy BWM, we compute the prioritization and ranking of the challenges. Tables 8 and 9 give the prioritization of government and organizational challenges.

Table 8. Prioritization of government challenges.

	ME1	ME3	ME6	ME11	ME14
DM1	0.078	0.334	0.22	0.258	0.109
DM2	0.138	0.263	0.373	0.088	0.138
DM3	0.096	0.211	0.31	0.172	0.211
DM4	0.346	0.256	0.143	0.098	0.157
DM5	0.238	0.362	0.121	0.086	0.194
DM6	0.325	0.233	0.131	0.093	0.219
DM7	0.238	0.362	0.121	0.086	0.194
DM8	0.091	0.142	0.384	0.113	0.271
DM9	0.097	0.147	0.363	0.144	0.248
DM10	0.104	0.107	0.368	0.152	0.269
Average	0.175	0.242	0.253	0.129	0.201
Rank	4	2	1	5	3

Table 9. Prioritization of organizational challenges.

	M4	M7	M8	M10	M16
DM1	0.347	0.230	0.230	0.102	0.092
DM2	0.380	0.140	0.211	0.118	0.150
DM3	0.334	0.228	0.221	0.128	0.089
DM4	0.231	0.231	0.231	0.066	0.242
DM5	0.331	0.137	0.306	0.131	0.094
DM6	0.137	0.306	0.331	0.094	0.131
DM7	0.342	0.098	0.221	0.098	0.241
DM8	0.232	0.325	0.093	0.132	0.218
DM9	0.353	0.153	0.251	0.142	0.101
DM10	0.277	0.355	0.096	0.108	0.164
Average	0.296	0.220	0.219	0.112	0.152
Rank	1	2	3	5	4

5. Discussion and Finding

Assessing the sustainability of sovereign credit in the MENA region requires a critical examination of the various challenges that sharply define credit. To understand the challenges and strategies that must be adopted to overcome the sovereign credit risks and integrate sustainability the current study adopts a multi-criteria approach. The first part answers the first research question "What impact do ESG issues have on the sovereign credit rating of the MENA region?" These include a variety of challenges including political instability, industrialization, gender inequality, quality of education, health care, climate insecurity, water scarcity and loss of biodiversity. The second research question "What are the obstacles to integrating SDGs and ESG ratings for MENA sovereign credit assessment?" is answered by shortlisting these challenges based on their weights derived from the Fuzzy Delphi methodology It was challenging to obtain precise and deterministic data from the stakeholders, instead, data obtained was vague, incomplete, or subject to ambiguity. The Fuzzy Delphi method is used to manage this uncertainty by allowing authors to work with fuzzy or imprecise information. The third research question "How can we identify these crucial issues and prioritize them?" is answered by prioritizing the challenges using Fuzzy BWM to generate weights. After three phases of analysis, we classified the challenges in two categories: governmental and organizational challenges and ranked the challenges as given in **Table 10** and **Table 11**. The list of the SDGs is given in Appendix 3.

Table 10. Ranks of government challenges.

Notation	Rank	Challenge	Statement
ME1	4	Standardization	Lack of standardized frameworks for ESG assessment and SDG alignment complicates harmonization efforts
ME3	2	Political Instability (SDG16)	Geopolitical tensions and regime changes in the region introduce uncertainty, affecting long-term sustainability strategies aligned with SDGs.
ME6	1	Greenwashing (SDG13) (SDG7)	Lack of clear criteria for assessing genuine ESG performance increases the risk of greenwashing, undermining SDG alignment efforts.
ME11	5	Education Quality (SDG4)	Disparities in education quality and access hinder progress towards SDG 4 (Quality Education) and socio-economic development
ME14	3	Migration Challenges (SDG17) (SDG16)	MENA's complex migration dynamics require inclusive policies and regional cooperation to address displacement, labor mobility, and refugee integration.

Based on the evaluation of the factors, we have obtained the ranking, which signified the importance of each challenge in the context of sovereign assessment in the MENA region. The first rank is obtained by "Greenwashing" which impacts SDG13 and SDG7. Greenwashing occurs when companies falsely communicate their commitment to social and environmental responsibility. Biased rating systems, influenced by companies paying for higher ratings, contribute to unsustainable choices by investors and

consumers. companies in the region are beginning to recognize the importance of credible sustainability practices. Globally, there is a growing awareness that pressures the businesses to adopt robust frameworks and transparent reporting to avoid greenwashing. The companies in the MENA region have started to understand the need for credible sustainability practices. The second rank for the sovereign assessment is obtained by “Political Instability” which impacts SDG16. The problem with political instability is that with the changing government, all the resources are put in for the internal issues while ignoring the long-term sustainable growth. The changes in authoritarian governance, economic disparities, sectarian divisions, and external forces cause the issues of growth and development in the area. This growing instability causes the lack of development in the region by undermining governance structures, and hampering the peace and prosperity of the region. Political instability's impacts on SDG 16, "Peace and Justice". The third rank is obtained by “Migration Challenges” which impacts SDG17 and SDG16. Migration is a common problem in the conflict-affected areas of the MENA region. Remittances support poor households and ESG ratings should consider their impact. This large-scale movement strains resources in host countries, causing social and economic issues, and often leading to social fragmentation and lack of development. The influx of migrants also poses significant challenges to public services, including healthcare, education, and housing, while the loss of human capital in origin countries hampers their potential for future development.

Rank 4- Lack of Standardized Frameworks: Most MENA companies lack extensive ESG strategies due to politics, religion, and culture. Harmonizing ratings with international frameworks and SDGs is difficult due to variable material issues determined by stakeholders. Measuring company impact and contributions towards SDGs is challenging due to the variability of material issues. Using international or country-specific standards can create an inaccurate reflection of the company’s impact.

Rank 5- Education Quality and its Role in Achieving SDG4: The education gap in the MENA region challenges ESG ratings and SDG 4. Private education varies in quality, making it difficult to compare to public education. Public education in many MENA countries falls below SDG 4 standards, despite potentially higher ESG ratings for private education. This misrepresentation could lead to decreased support for public education. In countries with high levels of private education, inequality would worsen as only a portion of the population achieves higher SDG 4.

Table 11. Ranks of organizational challenges.

Notation	Rank	Challenge	Statement
ME4	1	Technological Infrastructure	Inadequate technology infrastructure restricts access to digital tools necessary for ESG data collection, analysis, and reporting.
ME7	2	Access to Finance (SDG8)	Limited access to sustainable finance options constrains investments in projects aligned with ESG principles and SDGs.
ME8	3	Institutional Capacity (SDG9)	Weak institutional structures and governance frameworks hinder effective coordination of ESG and SDG initiatives at national and regional levels. (World Bank, 2021)
ME10	5	Gender Inequality (SDG5)	Persistent gender disparities in the MENA region require gender-sensitive policies and initiatives to advance gender equality and women's empowerment
ME16	4	Infrastructure Deficit (SDG11) (SDG12)	Inadequate infrastructure in transportation, energy, and sanitation hampers socio-economic development and SDG attainment.

Based on the evaluation of the organizational challenges, we have obtained the ranking, which signified the importance of each challenge in the context of sovereign assessment in the MENA region. The first rank is obtained by Technological Infrastructure. Building an impact assessment tool for ratings is easier. Questions arise about its necessity compared to the direct rating of SDG impact. Inter-connectivity is important for data exchange. AI and ML algorithms simplify data translation. This affects the impending economic growth and development of the region. Inadequate internet connectivity, limited access to digital tools, and

insufficient investment in tech infrastructure hinder the region's ability to participate fully in the global digital economy. Investing in technology infrastructure has pros and cons. Efficiency improvements and interconnectivity are benefits, but building and maintaining software is costly and choosing is difficult. The second rank is obtained by Access to finance. The finance industry is shifting towards sustainable finance and responsible investment. The MENA region can align with ESG funding sources, attracting foreign investment. Small businesses lack finance for ESG policies, but ESG ratings can create targeted financial products. Small enterprises, businesses owned by marginalized groups, such as women and young entrepreneurs which are needed for employment creation and innovation, often struggle to get funding due to stringent lending criteria, inadequate financial infrastructure, and political instability. This financial exclusion limits their ability to expand, invest in new technologies, and compete globally. Following this Institutional Capacity is ranked third. Determining ESG capacities is crucial as national differences in endorsing principles are found. Egypt lacks ESG priority without legislation, while Lebanon mandates CSR. Legislation aids ESG actions and impacts the UN Global Compact. Human capital and stakeholder education are vital. Low awareness is prevalent. In Jordan, confusion between ESG, corporate governance, and CSR poses challenges. Stakeholders emphasize ESG as an investment, not charity.

Rank 4- Infrastructure Deficit: The fragile states in the region must decrease conflict risk. FDI is low, and the private sector lacks interest in investing in infrastructure. Investment in infrastructure is crucial for stability and conflict prevention. The absence of reversible options may cause youth migration. The "Resource curse" theory hinders development. The region has an infrastructure deficit, with funding focused on IT.

Rank 5- Gender Inequality: The GCC population declines due to low fertility and longer life. The workforce gender gap is linked to ageing, not a new generation. Discouraged female workers and early retirement drive employment disparity. Gender inequality and empowerment are debated. Female labor force participation was 22.3% lower than males in 2018, with inactivity among women and unemployment both factors.

ESG rating agencies need to provide forward-looking guidance for companies and investors to align decisions with the SDGs. However, current ratings focus too much on past events and present risks, resulting in limited impact on country behaviour and SDG alignment.

An SDG alignment strategy aligns a country's activities with UN sustainable development goals. It involves mapping goals, removing conflicts, and communicating positions. Data and ESG ratings assess performance. Countries connected to social and environmental issues feel pressure to align. Measuring ESG leads to volatility in ratings. Understanding this dynamic is important for industries gaining insight into global ESG changes. Harmonizing ESG and SDG frameworks is crucial for accurate evaluation and incentivizing sustainable paths. National context and cross-country disparities require adjustments to SDGs. ESG ratings consider host-country institutions and policies related to meeting SDG targets. Aligning ESG and SDG variables facilitates impact assessment and feedback to policymakers for achieving global sustainability. Efforts to harmonize ratings to SDG goals will promote foreign investment in sustainability. MENA region has a low FDI share in SDG sectors compared to other areas. This may be due to investors targeting non-sustainable sectors. Correlating SDG goal rating to ESG ratings will promote investment in overlooked areas.

Conflicting ratings on a country can confuse investors, increasing the cost of capital due to perceived risk. A study found a negative correlation between ESG and cost of capital. Improving ESG ratings reduces risk and cost of investment. Increased investment demand for MENA countries in SDG sectors, providing

infrastructure finance opportunities of approximately USD 400 billion annually, implies a strong potential presence of foreign investors. This fact creates an urgent need for accurate insight and ratings on ESG-related concerns in the region to investors, given the potential risk to investment sustainability linked to the bulk of external finance.

The ability to compare ESG performance across countries through a unique rating system is appealing to policymakers and stakeholders. It allows for accountability and incentives for improvement.

However, the fragmented nature of ESG ratings makes it difficult to compare performance even within an industry, let alone across countries. Inconsistent ratings are caused by variations in definitions and data sources. It will need cooperation between the current rating agencies or the creation of a public sector or transnational rating agency to resolve this fragmentation. It becomes more practical to compare ESG ratings to the SDGs if a standardized grading methodology is established.

6. Implication of Findings

The paper highlights key issues with SDG&ESG integration and evaluation of MENA sovereigns, with technological ME4 being the most significant challenge. This underlines the importance of resources dedicated to the use of information technology in the collection, generation, storage and dissemination of ESG data. The second-lowest score is achieved in decreased access to sustainable finance (ME7), which has led to recommendations on the development of incentives and instruments to support sustainable investments. The third challenge is weak institutional capacity (ME8), describing the necessity to improve the quality of governance and develop more effective institutions. The fourth one, namely infrastructure deficiency (ME16) calls for the need to approach infrastructural development to encompass sustainability strategies. Last, inequality based on gender (ME10) is ranked in the fifth place and therefore showing that there is need for gender sensitive policies to be put in place and more emphasis being placed on the roles that women should be empowered to undertake.

Prioritizing challenges in sovereign credit ratings and economic growth has significant implications for stakeholders including financial institutions, policymakers and investors in the MENA area. Facing these challenges, strengthened efforts are encouraged to develop focused intervention programs, promote institutional transformation, and achieve cross-functional cooperation. It is crucial to improve the sustainable management of public debt to increase institutional capacity, support long-term fiscal sustainability, promote gender equality, invest in infrastructure, and improve political stability. Ongoing research projects, stakeholder engagement and policy implementation are key to addressing the issues at hand and driving the sustainability agenda forward in the MENA region.

Investors can contribute to sustainable development in the MENA region if environmental, social and governance ratings and the Sustainable Development Goals are synchronized. By highlighting the most profitable investment potential, this framework will simplify and enhance the clarity of the investment process.

A global framework would encourage sustainable development, which would encourage foreign investors to make beneficial contributions. Investment companies and stakeholders would prioritize this. Using a ratings system, investors may concentrate on certain objectives, such as infrastructure investments to reduce poverty and create jobs. Improved extra-financial ratings can direct investors toward choices that are more advantageous for their business and the area.

The trend in sovereign ESG investing will be driven by national policies tied to international agreements and country sustainability goals, with a focus on climate change. Higher ESG ratings benefit countries in terms of lower borrowing costs and greater availability of capital for sustainable development. This aligns with the SDGs, as substantial private capital mobilization is needed to achieve them. Country-by-country ESG evaluation allows for more transparency and accountability. Policymakers will need to prioritize and coordinate ESG-related policies to improve their ratings. Comparisons with peers will also compel policymakers to maintain competitive sustainability performance.

The difference between the SDGs and the present ESG rating will determine how this transition affects different countries and industries. Because this would need revisions to fulfil the new sustainable development requirements, stakeholders with high ESG ratings could not accept this approach. The degree to which stakeholders would have to change their behaviors would increase with the SDGs' present ranking.

7. Conclusion

The social, political and economic conditions of the MENA region make it a difficult zone to implement sustainable sovereign credit in this area. The diversity of the region's political, geopolitics and commercial situation makes it difficult for sovereign credit to align with SDG objectives. While the MENA region has improved in many areas, there should still be many areas for improvement in terms of public credit and sustainability. Multi-stakeholder alignment, sustained political commitment and innovative ideas are needed to address these challenges and promote equitable and sustainable development in the MENA region. Based on addressing important issues in sovereign credit risk assessment and opening up new possibilities, researchers have enhanced our knowledge of sovereign credit adequacy and the consequences of excessive growth sustainability and global economic stability. This study aims to understand the challenges associated with sovereign credit risk assessment in terms of ESG aspects in the MENA region, which is the main research study intended in this study. In conclusion, this paper explores the complex interactions between government credit appraisals and ESG indicators in the MENA region. This paper focuses on the impact of ESG factors in determining creditworthiness examines the complexity of SDGs in SG levels and provides important insights into the changing sovereign credit policy in the MENA region using a Delphi method ease of use, analysis of the subject matter and ambiguity it provides so a structured approach to identifying and prioritizing these challenges. Finally, the findings of the study enhance our knowledge of the challenges of including sustainability factors in universal credit scales and highlight the need for comprehensive research and strictly to promote sustainable development in the MENA context.

7.1 Policy Implication

Addressing these challenges requires the implementation and implementation of targeted intervention models. Policymakers must attach more importance to institutional reforms that seek to improve the efficiency and transparency of government borrowing regulations. The primary objectives of these policies should be to improve cost management, encourage organizational flexibility, and encourage collaboration between relevant departments and interested parties.

The mechanism by which government loans are disbursed must be transparent and efficient, and that requires institutional reforms. This will include changes in organizational and governance structures and initiatives aimed at building institutional resilience. Policymakers and financial institutions should give higher priority to managing public debt. This means developing strategies to mitigate credit risks, such as these volatile political environments, and releasing funds for long-term sustainable investment and institutional capacity building, sustainable public debt management, and prioritized infrastructure investment. By implementing these measures, policymakers can strengthen sustainable development centers and enhance prosperity and economic stability in the MENA region. Research, engagement with

stakeholders, and policy implementation must continue to resolve concerns and advance the sustainability agenda.

7.2 Limitations and Future Scope

The fact that this study focuses mostly on issues with sovereign credit assessment and the SDGs in the MENA area is one of its shortcomings. While the paper makes efforts to identify the challenges, the validation process could benefit from enhancement through the application of statistical techniques on a more extensive dataset. The dataset can be further enhanced to include more longitudinal studies in the area. The data can also be validated using a different set of decision-makers to check the consistency and validity of the results. The study does not test the challenges by applying further quantitative testing methods.

The findings of this research contribute to the understanding of the limitations regarding the adoption of SDGs and ESG fundamentals in credit rating of sovereigns in the MENA region. However, certain limitations that are inherent to quantitative cross-sectional studies should be noted. Despite the strict criteria for selecting the experts, their number was not very large; all the selected experts had at least 10 years of experience. This may have locked out characteristics from potential perspectives from youthful and fresh but resourceful employees. Moreover, the study draws data exclusively from the MENA region and may, therefore, be less applicable to other regions with diverse socio-political and economical characteristics. Also, the study contains a vast perspective of ESG criteria, which may lead to binocular vision and the absence of comprehensive descriptions of each criterion.

In order to advance the research agenda that this paper has contributed to, we have identified several areas of future research. It may be useful to compare the results obtained for CEE with other areas: Sub-Saharan Africa, Southeast Asia, and Latin America, taking into account the differences in socio-economic and political development to determine how they affect the inclusion of SDG and ESG indicators in credit risk assessments of sovereigns. It has also been suggested that more micro research, in which ESG criteria that focuses on a particular aspect of the environment is examined, could provide more insight of these issues and possibilities within the domain.

A longitudinal design would be useful in documenting changes in the degree of ESG integration over time and evaluating the effectiveness of policies or strategies to advance sustainability and address key societal issues. As for the future research considerations, the investigation of potential applications for the newly emerged technologies like blockchain and artificial intelligence in increasing effectiveness of ESG data gathering and evaluation seems rather promising. Through identifying these limitations and suggesting the future research avenues, scholars would be in a better position to enhance the comprehension of ESG and SDG integration into sovereign credit ratings and thus enhancing better and sustainable financial systems across the world.

Conflict of Interest
There is no Conflict of interest.

AI Disclosure
The author(s) declare that no assistance is taken from generative AI to write this article.

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Appendix 1

Table A1. Questionnaire for data collection.

S. No.	Questions	Strong prominence	High prominence	Neutral	Low prominence	No prominence
1.	How important is data availability in sustainable sovereign credit in the MENA region?					
2.	How important is data quality in sustainable sovereign credit in the MENA region?					
3.	How important is standardization in sustainable sovereign credit in the MENA region?					
4.	How important is contextual relevance in sustainable sovereign credit in the MENA region?					
5.	How important is cultural sensitivity in sustainable sovereign credit in the MENA region?					
6.	How important is the regulatory environment in sustainable sovereign credit in the MENA region?					
7.	How important is political instability in sustainable sovereign credit in the MENA region?					
8.	How important are resource constraints in sustainable sovereign credit in the MENA region?					
9.	How important is technological infrastructure in sustainable sovereign credit in the MENA region?					
10.	How important is capacity building in sustainable sovereign credit in the MENA region?					
11.	How important are language barriers in sustainable sovereign credit in the MENA region?					
12.	How important is stakeholder engagement in sustainable sovereign credit in the MENA region?					
13.	How important is data privacy in sustainable sovereign credit in the MENA region?					
14.	How important is greenwashing in sustainable sovereign credit in the MENA region?					
15.	How important is fragmentation in sustainable sovereign credit in the MENA region?					
16.	How important is access to finance in sustainable sovereign credit in the MENA region?					
17.	How important is institutional capacity in sustainable sovereign credit in the MENA region?					
18.	How important are conflict zones in sustainable sovereign credit in the MENA region?					
19.	How important is climate vulnerability in sustainable sovereign credit in the MENA region?					
20.	How important is water scarcity in sustainable sovereign credit in the MENA region?					
21.	How important is the energy transition in sustainable sovereign credit in the MENA region?					
22.	How important is youth unemployment in sustainable sovereign credit in the MENA region?					

Table A1 is continued…

23.	How important is gender inequality in sustainable sovereign credit in the MENA region?					
24.	How important is education quality in sustainable sovereign credit in the MENA region?					
25.	How important are urbanization challenges in sustainable sovereign credit in the MENA region?					
26.	How important is biodiversity loss in sustainable sovereign credit in the MENA region?					
27.	How important is healthcare infrastructure in sustainable sovereign credit in the MENA region?					
28.	How important is corruption in sustainable sovereign credit in the MENA region?					
29.	How important are migration challenges in sustainable sovereign credit in the MENA region?					
30.	How important is food insecurity in sustainable sovereign credit in the MENA region?					
31.	How important is land degradation in sustainable sovereign credit in the MENA region?					
32.	How important are natural disasters in sustainable sovereign credit in the MENA region?					
33.	How important is the infrastructure deficit in sustainable sovereign credit in the MENA region?					
34.	How important is youth radicalization in sustainable sovereign credit in the MENA region?					
35.	How important is the digital divide in sustainable sovereign credit in the MENA region?					
36.	How important are labor rights in sustainable sovereign credit in the MENA region?					
37.	How important is cultural heritage preservation in sustainable sovereign credit in the MENA region?					
38.	How important is economic diversification in sustainable sovereign credit in the MENA region?					
39.	How important is access to clean water in sustainable sovereign credit in the MENA region?					
40.	How important is the lack of natural resource management in sustainable sovereign credit in the MENA region?					
41.	How important is the waste management system in sustainable sovereign credit in the MENA region?					

Appendix 2

The optimal fuzzy weight for each criterion is the one where, for each fuzzy pair $\widetilde{W}_B/\widetilde{W}_j$ and $\widetilde{W}_j/\widetilde{W}_w$, it should have $\frac{\widetilde{W}_B}{\widetilde{W}_j} = \tilde{a}_{Bj}$ and $\frac{\widetilde{W}_j}{\widetilde{W}_w} = \tilde{a}_{jw}$. To satisfy these conditions for all j, it should determine a solution where the maximum absolute gaps $\left|\frac{\widetilde{W}_B}{\widetilde{W}_j} = \tilde{a}_{Bj}\right|$ and $\left|\frac{\widetilde{W}_j}{\widetilde{W}_w} = \tilde{a}_{jw}\right|$ for all j are minimized. We use the following constrained optimization problem for determining the optimal fuzzy weights $(\widetilde{w}_1^*, \widetilde{w}_2^*, \dots, \widetilde{w}_n^*)$ as

follows.

$$min\ max_j \left\{ \left| \frac{\widetilde{W}_B}{\widetilde{W}_j} - \tilde{a}_{Bj} \right|, \left| \frac{\widetilde{W}_j}{\widetilde{W}_w} - \tilde{a}_{jw} \right| \right\}$$

Subject to:

$$\sum_{j=1}^{n} R\left(\widetilde{W}_j\right) = 1$$
$$l_j^w \le m_j^w \le u_j^w$$
$$l_j^w \ge 0, j = 1,2 \ldots, n$$

where, $\widetilde{w}_B = (l_B^w, m_B^w, u_B^w)$, $\widetilde{w}_j = (l_j^w, m_j^w, u_j^w)$, $\widetilde{w}_W = (l_w^w, m_w^w, u_w^w)$, $\tilde{a}_{Bj} = (l_{Bj}, m_{Bj}, u_{Bj})$, $\tilde{a}_{jw} = (l_{jw}, m_{jw}, u_{jw})$. (6) can be transferred to the following nonlinearly constrained optimization problem.

$$\min \xi$$
$$\text{s.t.} \begin{cases} \left| \frac{W_B}{W_j} - a_{Bj} \right| \le \xi \\ \left| \frac{W_j}{W_w} - a_{jw} \right| \le \xi \\ \sum_{j=1}^{n} R(w_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1,2,\ldots,n \end{cases}$$

where, $\xi = (l^\xi, m^\xi, u^\xi)$.

$$\min \xi^*$$
$$s.t. \begin{cases} \left| \frac{(l_B^w, m_B^w, u_B^w)}{(l_j^w, m_j^w, u_j^w)} - (l_{Bj}, m_{Bj}, u_{Bj}) \right| \le (k^*, k^*, k^*) \\ \left| \frac{(l_j^w, m_j^w, u_j^w)}{(l_j^w, m_j^w, u_j^w)} - (l_{jw}, m_{jw}, u_{jw}) \right| \le (k^*, k^*, k^*) \\ \sum_{j=1}^{n} R(W_j) = 1 \\ l_j^w \le m_j^w \le u_j^w \\ l_j^w \ge 0 \\ j = 1,2,\ldots,n \end{cases}$$

Considering we suppose $\xi^* = (k^*, k^*, k^*), k^* \leq 1^{\xi}$, then (7) can be transferred as

$$\min \xi^*$$

$$s.t. \begin{cases} \left| \frac{(l_B^w, m_B^w, u_B^w)}{(l_j^w, m_j^w, u_j^w)} - (l_{Bj}, m_{Bj}, u_{Bj}) \right| \leq (k^*, k^*, k^*) \\ \left| \frac{(l_j^w, m_j^w, u_j^w)}{(l_j^w, m_j^w, u_j^w)} - (l_{jw}, m_{jw}, u_{jw}) \right| \leq (k^*, k^*, k^*) \\ \sum_{j=1}^{n} R(W_j) = 1 \\ l_j^w \leq m_j^w \leq u_j^w \\ l_j^w \geq 0 \\ j = 1, 2, \ldots, n \end{cases}$$

Table A2. Initial pairwise comparison for Governmental challenges.

	BEST- TO- OTHERS (BO)					**OTHERS-TO-WORST (OW)**				
	ME1	**ME3**	**ME6**	**ME11**	**ME14**	**ME1**	**ME3**	**ME6**	**ME11**	**ME14**
DM1	AI	EI	FI	WI	VI	EI	AI	VI	VI	WI
DM2	VI	WI	EI	AI	VI	FI	VI	AI	EI	FI
DM3	AI	WI	EI	WI	WI	EI	VI	AI	WI	VI
DM4	EI	WI	FI	AI	FI	AI	VI	WI	EI	FI
DM5	FI	EI	VI	AI	FI	VI	AI	WI	EI	FI
DM6	EI	WI	FI	AI	WI	AI	VI	WI	EI	FI
DM7	FI	EI	VI	AI	FI	VI	AI	WI	EI	FI
DM8	AI	VI	EI	VI	WI	EI	FI	AI	WI	VI
DM9	AI	FI	EI	VI	WI	EI	WI	AI	FI	VI
DM10	AI	VI	EI	FI	WI	EI	WI	AI	WI	VI

Table A3. Initial pairwise comparison for Governmental challenges.

	BEST- TO- OTHERS (BO)					**OTHERS-TO-WORST (OW)**				
	M4	**M7**	**M8**	**M10**	**M16**	**M4**	**M7**	**M8**	**M10**	**M16**
DM1	EI	WI	FI	VI	AI	AI	FI	VI	WI	EI
DM2	EI	FI	WI	AI	VI	AI	AI	WI	EI	FI
DM3	EI	FI	WI	VI	AI	AI	VI	FI	WI	EI
DM4	WI	EI	WI	VI	FI	VI	AI	VI	EI	FI
DM5	EI	FI	WI	VI	AI	AI	WI	VI	WI	EI
DM6	FI	WI	EI	AI	VI	WI	VI	AI	EI	WI
DM7	EI	VI	WI	VI	FI	AI	WI	FI	EI	VI
DM8	WI	EI	AI	FI	WI	VI	AI	EI	WI	FI
DM9	EI	FI	WI	VI	AI	AI	WI	VI	WI	EI
DM10	WI	EI	AI	VI	FI	VI	AI	EI	WI	FI

Appendix 3

The list of Sustainable Development Goals (SDGs) are as follows:
SDG 1: No Poverty
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 4: Quality Education
SDG 5: Gender Equality
SDG 6: Clean Water and Sanitation
SDG 7: Affordable and Clean Energy
SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure
SDG 10: Reduced Inequality
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action
SDG 14: Life Below Water
SDG 15: Life on Land
SDG 16: Peace, Justice, and Strong Institutions
SDG 17: Partnerships for the Goals

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