

Toward Green Growth in Morocco: An Integrated Strategic Decision-Making Framework for Sustainable Development

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Abstract

Morocco's shift toward sustainable development still lacks a coherent strategic framework and explicit direction. Therefore, this study aims to develop an integrated strategic framework for the implementation of effective green growth strategies for Morocco's sustainable development. Thirty-two indicators were identified and categorized into five groups: environmental, social, governance, financial variability, and technological innovation. The fuzzy analytic hierarchy process (FAHP) was used to assess and rank the main indicators and their subindicators. Furthermore, within the study, we developed nine green growth strategic solutions for sustainable development. The fuzzy Vlsekriterijuska Optimizacija I Komoromisno Resenje (FVIKOR) approach was employed to evaluate and rank the proposed strategic solutions. The FAHP results revealed that environmental, governance, and technological innovation factors are the most pivotal among the five primary categories. Among the subfactors, transparency and disclosure received the top ranking, followed by social community engagement and market volatility. FVIKOR indicated that the most effective strategies for promoting green growth in Morocco include improving transparency and disclosure methods, issuing green bonds, and increasing shareholder engagement. This research provides essential insights for developing effective strategies to foster green growth in Morocco, thereby aiding Morocco's progress in sustainable performance. It also offers practical guidance for policymakers by identifying priority areas improving transparency, expanding green finance, and enhancing stakeholder engagement to accelerate Morocco's green growth and sustainable development efforts.

Keywords: Sustainable development; green growth; integrated framework; strategic decision making; environmental sustainability; Morocco

1. Introduction

Sustainable development is currently considered a critical issue at the intersection of social equity, economic variability, and environmental preservation. Promoting sustainable practices has never been more urgent, as the world faces severe challenges such as pollution, resource scarcity, climate change, and biodiversity loss (D'Adamo and Rossi, 2024). Sustainable development was first introduced in 1987 in the Brundtland Report published by the World Commission on

Environment and Development (WCED), and it was defined as the responsible use of natural resources to meet the needs of the present generation without compromising the needs of future generations (United Nations, 1987). To guide nations and countries around the world to reach sustainability and address these environmental challenges, the United Nations introduced 17 sustainable development goals (SDGs). The scope of action of these SDGs revolves around three main sustainable pillars (economic, social, and environmental). These seventeen sustainable goals are also referred to as the five Ps (people's well-being, planet protection, shared prosperity, peace and justice, and finally partnership), which act as a strategic framework for all countries to follow (United Nations, 1987), (United Nations, 2015).

The kingdom of Morocco has implemented multiple measures to integrate sustainable development into its strategies and policies, and it has engaged in many partnerships with international communities to promote and support global practices and initiatives planned specifically to achieve the seventeen SDGs of the 2015–2030 United Nations (UN) Agenda (U.N. General Assembly, 2015). In this context, the 2014 Framework Law for the Environment and Sustainable Development is one of Morocco's main initiatives (Ministry Delegate to the Minister of Energy, Mines, Water, and Environment, 2014). Currently, the country's main sustainability strategy is in action, which is Morocco's 2030 national sustainable development strategy that aims to lead Morocco to a greener economy while maintaining a steady rise in economic and human growth while taking into account environmental issues (Chishti et al., 2021).

In January 2019, the United Nations Development Program (UNDP), along with the office of high commissioner implementation, signed partnerships to monitor and support the progress of the SDGs in Morocco, with the goal of increasing engagement and effectiveness in their implementation (Ibourk et al., 2021). The UN Development Assistance Framework (UNDAF)

2017–2021 includes this partnership in its strategic agreements. The main purpose behind this agreement is to create a reference framework for Morocco to follow for reporting and monitoring as well as for informing the public and policymakers about the country's achievements in this regard.

Morocco's rank in terms of SDG performance decreased from 69th place to 84th place. Although this rank is higher than the average rank of the MENA region, it is still lower than the global ranking. Morocco is ranked behind both Tunisia and Algeria in North Africa. However, the country is still dedicated to enhancing its SDG performance internationally by achieving critical sustainable goals, such as good health and well-being, quality and education, in areas where progress has been slow compared to others (Daoudi, 2024).

Morocco is still regarded as one of the top-ranked countries in terms of environmental development. The country continues to rank first in areas such as energy usage, climate policy, and greenhouse gas emissions (Kaitouni et al., 2023). For instance, the government has recently approved new large-scale solar power projects and initiated plans for green hydrogen production, reinforcing its aim to source over 50% of its electricity from renewable energy by 2030 (IEA, 2019). Such initiatives demonstrate Morocco's ongoing commitment to ambitious green policies. Morocco's recent drop in SDG performance ranking underscores the objective of this study, which aims to leverage environmental, social, and governance factors; financial variability; and technological innovations, such as financial technology, to develop policies and strategies that help the country improve its SDG performance and promote green growth.

Over the past 2 decades, environmental, social, and governance (ESG) factors have provided a comprehensive foundation to drive nations toward green growth and guide them toward improving their SDG performance. Socially responsible investment is a new emerging field that

considers (ESG) environmental, social, and governance factors in investment strategies. One purpose is to solve and address environmental and social issues and increase financial market responsibility (Folqué et al., 2021). Green finance helps facilitate sustainable development through allocating funds to projects and businesses that prioritize environmental responsibility. Green financing can be referred to as various green financial products and services designed to promote sustainability (Wang et al., 2022). Green finance helps fund private projects and initiatives that benefit the environment and society. Green finance is considered very important for addressing climate change issues, as it funds projects and initiatives that help achieve a low-carbon economy (Yoshino & Taghizadeh-Hesary, 2019).

In the renewable energy sector, the Intergovernmental Panel on Climate Change (IPCC) estimates, on the basis of forecasts that USD 2.4 trillion would be required until 2035, to keep global warming to 1.5 degrees Celsius greater than preindustrial levels (IPCC, 2022). The kingdom of Morocco is considered one of the major leaders in Africa in the worldwide energy transition; this is made possible through initiatives and programs conducted by Morocco that focus on reducing the impact of industrial global warming and producing energy from renewable energy sources (Boulakhbar et al., 2020). Green finance can make these investments possible, which encourages the adoption of energy efficiency, renewable energy resources, low-carbon technologies, and financial technology (Y. Li et al., 2023).

Financial technology includes many services, such as digital currencies, investment strategy management, retail financial services, and many other areas where banks predominate. Financial technology has been a key factor in promoting green growth. Digital solutions may encompass the implementation of subscription models or value-based pricing structures over time, incorporating contingencies. This approach contributes to the uncertainty and complexity

encountered by the customer organization, often leading to the rejection of innovative digital solutions (Sjödin et al. 2024). These technologies can help achieve international SDGs and mitigate environmental issues. Financial technology helps promote green finance. The latter is considered very important for financing environmental and sustainable initiatives worldwide (Niu et al., 2024). Three countries in North Africa, Morocco, Egypt, and Tunisia, are showing support for the fintech industry. According to a study by CGAP (2020), there are 349 active fintech companies in the Arab region, 35% of which are based in North Africa. These companies include Moroccan companies (Naz et al., 2022).

Despite the country's initiatives and efforts to promote green growth, most prior studies have focused on sustainability in Morocco in a more general and broad way without focusing on specific criteria that are important for developing strategies and policies that can guide the country toward green growth. This gap makes decision-making in the context of green growth initiatives ineffective for policymakers in Morocco. This gap needs to be addressed by developing suitable and appropriate policies that can help the country promote green growth through enhancing its SDG performance. Accordingly, the objective of this paper is to design and propose a clear framework for the development and implementation of policies to help Morocco transition to greener growth. The study uses the fuzzy analytical hierarchy process (FAHP) to analyze the main factors and their subfactors, which include environmental, social, and governance (ESG) factors; financial variability; and technological innovations with a focus on financial technologies that help promote green finance practices. The fuzzy VIKOR method is used to rank green growth policies developed to aid Morocco in improving its sustainability practices and enhancing its SDG performance.

FAHP and fuzzy VlseKriterijuska Optimizacija I Komoromisno Resenje (FVIKOR) are two multicriteria decision-making methods that help address uncertainty and ambiguity in policymaker evaluations and preferences (Suganthi, 2018). Prior studies have used both FAHP and FVIKOR for better decision-making, improving the handling of vagueness and decision-making and increasing reliability. These two methods have been used in several studies to evaluate sectorial investments for sustainable development and in other fields (Mahmudah et al., 2024). This paper has crucial implications for the promotion of green growth in Morocco. By prioritizing important criteria such as ESG factors, financial variability and technological innovation, this research can guide the country's government, policymakers, stakeholders, and managers to promote a shift toward a green and more sustainable economy.

The study is structured as follows: Section 2 presents the literature review; a description of both the FAHP and FVIKOR methods is presented in Section 3; Section 4 presents the results of this study and an analysis of these results; a discussion of these findings is presented in Section 5; and finally, Section 6, the last section of this paper, contains the conclusion and future recommendations.

2. Literature review

Sustainable development includes initiatives in which businesses implement greener practices to minimize their effects on the environment and produce eco-friendly goods (Mensah, 2019). Another study argues that sustainable development is a fundamental concept in international development policies and agendas. It offers a way for social communities to engage with the environment without compromising future generations of resources (Jiakui et al., 2022). Several countries have started to combine both economic and green growth practices, such as green finance and green technology innovation. These practices represent cooperation and synergy between the

economy, environmental development, and resources for one purpose, which is to achieve the SDGs (Ikram et al., 2021).

Green growth is considered an emerging strategy for sustainable development; it addresses current issues related to climate change, biodiversity loss and resource scarcity. Currently, the promotion of green growth has become very important for the achievement of sustainable development goals (Belmonte et al., 2021). A prior study by Koondhar et al. (2021) argued that green growth has an indirect relationship with carbon emissions; according to the findings of this study, a substantial increase in CO₂ emissions results in a decrease in green growth. Several studies have attempted to define green growth because the concept does not have a clear definition or conceptual understanding. In 2019, the OECD explained that green growth is a strategy that aims to support economic growth, sustainability and the responsible usage of natural resources while addressing environmental issues (Sarkodie et al., 2024). This particular definition led to the development of a framework with multiple specific main factors: (1) environmental factors, (2) social factors, (3) governance factors, (4) financial variability, and (5) technological innovation. This study uses these main factors and multiple subfactors in the Moroccan context via the fuzzy analytic hierarchy process (FAHP) and the FVIKOR methods to develop strategies and rank them so that these ranked strategies can be part of the national economic strategy to promote green growth.

These five categories encompass the key dimensions of sustainable development. By including environmental, social, and governance pillars alongside financial variability and technological innovation, the framework integrates economic stability and technological progress with traditional sustainability factors. Effective governance practices (e.g., transparency and accountability) can drive better environmental and social outcomes (Oyewo et al., 2023), while

technological innovation accelerates solutions to sustainability challenges (Giuzio et al., 2024). Additionally, ensuring financial stability through green finance and risk management is essential for funding sustainable initiatives (Wang et al., 2022). Prior studies highlight the importance of such integrated approaches; for instance, strong corporate governance correlates with improved environmental performance (Orazalin & Mahmood, 2021) and green finance is vital for achieving SDGs (Ronaldo and Suryanto, 2012). Therefore, prioritizing these interrelated factors is theoretically justified, as it aligns with sustainable development literature and addresses Morocco's multi-faceted sustainability goals.

Environmental, social, and governance issues negatively impact sustainable growth. Resource scarcity, pollution and climate change are considered all environmental problems. However, diversity and inclusion, labor regulations, and human rights are all considered social aspects (Sinha et al., 2021). ESG factors are considered very important for sustainable development and green growth, and interest in ESG factors has increased on a global scale because of several factors, such as the worldwide coronavirus crisis and other current concerns related to society and the environment (T. Li et al., 2021).

In the context of sustainability, the concept of green finance is considered the process of increasing financial flows from the private, public, and nonprofit sectors (investments, issuance, banking) to help support sustainability initiatives (Sun et al., 2025). Therefore, green finance is important for meeting the sustainable development goals of the SDGs that consider green growth. Green growth can be difficult to achieve without the support of green finance practices that help reduce and address issues resulting from climate change (Desalegn & Tangl, 2022). A study conducted by Nepal et al. (2024) argued that green finance enhances the efficiency of energy usage and helps fund projects that facilitate the transition into clean energy sources, which makes it a

crucial part of green growth. Another study revealed that green finance, ecological creativity and innovation have positive effects on the achievement of sustainable development goals in ASEAN countries (Nchofoung et al., 2024).

With respect to technological innovation and green growth, Sohag et al. analyzed the correlation between green growth, energy and technological innovation for countries in the OECD as a sample. The findings of this paper revealed that there is a positive correlation between green growth and technological innovation in the long term when the CS-ARDL approach is used (Sohag et al., 2021). With the evolution of technological innovation levels, several governments in OECD countries acknowledge the important role of technological innovation in reducing CO₂ emissions. A prior study by Cheng et al. (2020) revealed that technological innovation and advancement substantially reduce greenhouse gas emissions through education and research and development (R&D) efforts and investments while reducing the impact of developing economies on emissions.

On the basis of the OECD report “Toward Green Growth”, decision makers and all policymakers should include the concept of green growth in their strategies and policies. To protect the environment, the economy should be dynamic, adaptable and effective while using resources; investments and innovation are considered crucial for green technology development, and this development can be achieved by increasing technological innovation. The latter is one way to address issues such as climate change and food shortages, which are considered obstacles to achieving green growth (Koondhar et al., 2022).

With respect to technological innovation, a new emerging technology has started to grow rapidly in financial aspects. Financial technology is considered the most advanced technology in the financial sector and is applied to help advance financial services and products in many developing countries. (Tian et al., 2023). Fintech is considered a major player in achieving

sustainable development. If this innovative technology is applied efficiently, it can enhance financial services that help promote sustainable development (Hasan et al., 2024).

After a detailed literature review, the study identified the main factors and subfactors. In this context, the FAHP method was used to assess the factors and subfactors used to develop strategies for green growth in Morocco. The table below presents the main factors and subfactors of this study. The details of the green growth factors and subfactors are presented in Table 1.

Table 1. Main factors and subfactors with brief description

Criteria	Subcriteria	Description	References
Environmental factors	Management of water resources	The practices that companies do to manage their natural resources including water, it focuses on how companies use these water resources and, on their conservation.	(Wan and Voulvoulis, 2024)
	Carbon emission reduction and climate change	Organization’s carbon footprint, and the investments made to lower greenhouse gas emissions and its impact on the environment and climate change.	(D’Orazio, 2023).
	Pollution prevention	The practices taken by companies to address pollution in air, soil, and water. It focuses on how the company handles waste and whether it respects environmental laws and regulations.	(F. Wang et al., 2021).
	Conservation of biodiversity and responsible resource management	The organization’s efforts dedicated to protecting biodiversity. It takes into consideration how the company preserve resources such as forests.	(St-Laurent et al., 2021).
	Renewable energy adoption and energy efficiency	Assessing the company’s efforts in supporting renewable energy initiatives such as solar energy and wind energy projects financially(investments), technically (technology usage), and logistically,	(Kul et al., 2020).

Social factors SOC	Green infrastructure and green building	The usage of eco-friendly materials in construction, it evaluates how committed the company to green building and construction by constructing green roofs for example that meets the standards of sustainable construction such as LEED (Leadership in Energy and Environmental Design).	(F. Zhang & Qian, 2024).
	Sustainable supply chain management	How committed are organizations to integrate sustainable practices into their supply chain operations like partnership with suppliers to use eco -friendly materials and help diminishing transportation emissions.	(Liew & Cao, 2024).
	Labor Practices and human rights	How the company treats it employees, and deals issues such as child labor and forced labor.	(Cao et al., 2024).
	Health and safety	How committed the company is to the safety and wellbeing of its employees is evaluated by examining how safe the internal work environment is.	(Li et al., 2023; D'Adamo et al., 2024).
	Diversity and inclusion	The company's commitment to provide equal opportunities as well as the policies implemented by the company with regard to diversity in terms of age, gender and ethnic groups.	(Otten et al., 2022)
	Company's community engagement and relations	Relationship the company and its community have; it takes into consideration the company's interactions with the community where it operates and how they impact the local development of the economy.	(Poyser & Daugaard, 2023).
	Access to essential services	The organization's impact on the ability of communities to access crucial services such as education and healthcare. It considers the commitment of the company to support social welfare by supporting educational programs for example.	(Garzoni et al., 2024a)

Governance factors GOV	Employee Development and Training	The company's efforts that are put to train and develop its workforce is evaluated in this subfactor such as investments made for the purpose of training and shaping the work force skills to align with the company's economic and sustainable goals.	(Bilderback, 2024)
	Social Community engagement	The level of community's engagement in the development and implementation of green growth practices and the impact of these communities on the execution of these policies and practices.	(Park, 2021).
	Executive compensation and accountability	The policies the company follows with regard to the compensation of executives. It takes into account how executives are responsible to shareholders and how their compensation aligns with the company's main purpose.	(Garzoni et al., 2024b)
	Board structure and composition	The board of directors' accountability and responsibility and on the practices the company follows with regard to their compensation, it also focuses on the BOD (board of directors) diversity, and responsibility.	(Orazalin and Mahmood, 2021)
	Risk management	How companies manage different levels of risks related to environmental, economic, and social aspects. Companies with efficient risk management practices can predict and minimize risks better.	(Mzoughi et al., 2022).
	Anti-corruption policies and measures	Anti-corruption procedures and policies implemented by companies; It evaluates how committed are to addressing corruption.	(Zhang, 2024).
	Transparency and disclosure	The organization's practices regarding transparency and disclosure, evaluating how accurately the company reports its performance and how committed	(Machado et al., 2021)

Financial variability FINV	Ethics and values	it is to providing transparent information. The company's ethical behavior-whether it operates ethically and how its practices impact the economy and the environment.	(Pangarso, 2024).
	Regulatory compliance	The company's compliance with regulations and laws that are related to sustainability and social issues.	(Niu et al., 2024).
	Cost efficiency	Evaluating cost saving practices implemented by companies that invest in sustainable projects and whether they operate at lower costs efficiently.	(Rubio et al., 2021).
	Return on investment (ROI)	The long term and short-term return on investment of projects implemented by companies to promote sustainability and green growth.	(Niu et al., 2024).
	Financial Risk management	Practices by companies to manage financial risk that could affect the progress of green growth. A stable financial framework that supports sustainable initiatives is crucial for green growth	(Mzoughi et al., 2022 ; Zhao et al., 2022).
	Financing access	How companies gain access to financial support (e.g., loans) to fund sustainable projects.	(Niu et al., 2024).
	Market volatility	Market volatility and fluctuation can significantly impact investments decision and financial stability.	(Zhao et al., 2022).
	Green Finance Innovations	Innovative practices that companies use in the context of green finance to promote green growth.	(Zhang et al., 2022).
	Research and development	The company's involvement in R&D, and how committed it is to be improving R&D practices that help in develop innovative sustainable products and services.	(Niu et al., 2024).
	Integration of FinTech	The important role of financial technology in promoting sustainable practices, including it helps track sustainability metrics	(Hasan et al., 2024 ; Xu et al., 2024).
Technological innovation TCHI			

	and promote green finance practices.
Supply chain optimization	The company's initiatives in lowering carbon footprints through sustainable supply chain practices. (Liew & Cao, 2024).
Digitalization	The integration of digital technologies and data analytics in the context of sustainable financial practices. (Luo & Wang, 2024; Ogunjimi et. al 2021).
Innovative Financial Instruments	Efforts done by companies to develop and implement cutting edge financial instruments (e.g., crowdfunding) that help raise money for sustainable projects. (Luo & Wang, 2024).

This study develops a strategic green growth framework to fill gaps in the current literature by incorporating key phases, pillars, and green growth strategies for sustainable development. The framework consists of two distinct phases: Phase I emphasizes planning, incorporating green growth policies; the Ministry of Planning Development; and government initiatives, underpinned by a vision of inclusivity and a focus on tackling environmental challenges. Prominent areas include the promotion of energy transition, the fostering of technological innovation, the encouragement of eco-friendly lifestyles, and the strengthening of international collaboration. The planning phase establishes a foundation through governance leadership, the engagement of multiple stakeholders, and investment in green finance and infrastructure. Phase II focuses on implementation, organized around three green growth pillars: (1) enhancing governance and financial ecosystems to improve transparency, green finance, and shareholder engagement; (2) advancing technological and institutional capacity through the development of infrastructure, regulations, and fintech support; and (3) fostering social responsibility and global collaboration by promoting community engagement and international partnerships. The pillars implement nine green growth strategies, including renewable energy transitions, environmental regulations, and

sustainable supply chain management, thereby ensuring a comprehensive approach to establishing a resilient and inclusive green economy. Figure 1 presents the strategic green growth framework for sustainable development, which forms the basis for the following methodological approach using integrated FAHP and FVIKOR.

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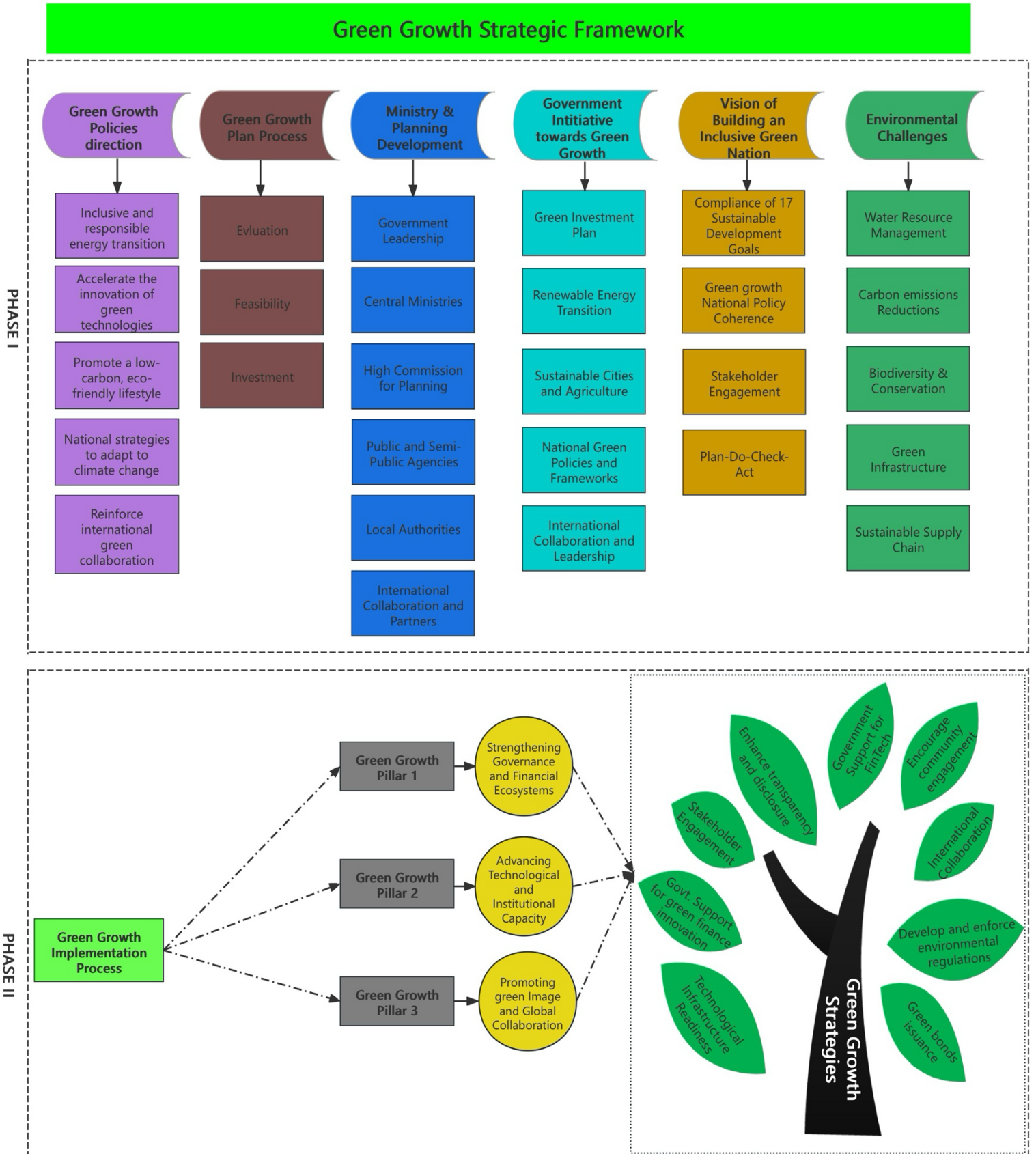


Figure 1: Strategic framework for green growth in Morocco, outlining key phases, pillars, and strategies

3. Research methods

The FAHP and FVIKOR methods were used in this study to evaluate the main factors, subfactors and to rank the strategies developed for green growth in Morocco. First, a comprehensive literature review was conducted to determine the main factors, their subfactors and the recommended strategies (as described in section 2). Next, the FAHP technique was applied to determine the relevant importance (weights) of each identified factor and subfactor, forming a hierarchical structure and using fuzzy logic to address ambiguity and uncertainty. Finally, the FVIKOR method was used to evaluate and rank the recommended strategies for promoting green growth in Morocco. Figure 2 displays the research's methodological framework.

3.1. Fuzzy analytical hierarchical process (FAHP) method

The FAHP method was first introduced by Saaty (1990) and is also known as the multicriteria decision-making (MCDM) method. This method is used in multiple fields to address uncertainty and ambiguity in decision making (Suganthi, 2018). This method uses fuzzy numbers to allocate values to the main factors and subfactors, which helps policy makers and decision makers address ambiguous and uncertain information. Table 2 provides a brief explanation of the triangular fuzzy number (TFN) scale.

Table 2. Triangular fuzzy number (TFN) scale

Code	Linguistic Variable	Triangular fuzzy Numbers
1	Equal Importance	(1,1,3)
2	Moderate Importance	(1,3,5)
3	Strong Importance	(3,5,7)
4	Very strong Importance	(5,7,9)
5	Extreme Importance	(7,9,11)

The fuzzy analytical hierarchical process method follows multiple steps that were developed by Gogus and Boucher. The first step is triangular fuzzy matrix (TFM) formulation as follows:

$$X_i = (l_i, m_i, u_i) \quad \dots(1)$$

Move on to create the first triangular fuzzy matrix (TFM) with the middle triangular fuzzy matrix (TFM):

$$X_m = x_{ijm} \quad \dots(2)$$

Next, using a geometrical mean, a second triangular fuzzy matrix (TFM) is created for the upper and lower bounds:

$$X_g = [\sqrt{x_{iju}x_{ijl}}] \quad \dots(3)$$

The second step is to create and compute the weight vector and lambda max:

The third step is consistency index (CI) creation:

$$CI_m = \frac{(\lambda_{max}^m - n)}{(n - 1)} \quad \dots(4)$$

$$CI_g = \frac{(\lambda_{max}^g - n)}{(n - 1)} \quad \dots(5)$$

The fourth step is consistency ratio (CR) creation:

$$CR_m = \frac{CI_m}{RI_m} \quad \dots(6)$$

$$CR_g = \frac{CI_g}{RI_g} \quad \dots(7)$$

If the values of the consistency ratios CR_m and CR_g are < 0.10 , the fuzzy pairwise matrices are coherent. In our application of FAHP, all pairwise comparison matrices satisfied this criterion ($CR < 0.1$), indicating an acceptable level of consistency in the expert judgments. By completing the above steps, the FAHP yields a set of weights for each main factor and

subfactor, reflecting their relative importance in the context of Morocco's green growth objectives. These weighted factors then inform the subsequent FVIKOR analysis

3.2. The fuzzy VIKOR method:

The FVIKOR concept was first introduced by Opricovic and Tzeng (2007) in the 1980s. This method can help decision makers address uncertainty in making decisions through calculating the weights of alternatives and ranking them. The ranking of these alternatives will help develop optimal solutions to address decision-making problems with conflicting factors. An optimal solution is an agreement that is reached by reciprocal concessions; this solution can be considered the most realistic solution and the most feasible one (Opricovic and Tzeng 2004).

The fuzzy VIKOR method follows these steps:

Step 1. Develop a performance-based fuzzy matrix and weight vector:

$$\tilde{W} = \begin{matrix} & \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{matrix} O_1 \\ \vdots \\ O_n \end{matrix} & \begin{bmatrix} \tilde{p}_{11} & \tilde{p}_{12} & \cdots & \tilde{p}_{1n} \\ \tilde{p}_{21} & \tilde{p}_{22} & \cdots & \tilde{p}_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \tilde{p}_{m1} & \tilde{p}_{m2} & \cdots & \tilde{p}_{mn} \end{bmatrix} \end{matrix} \quad \dots(8)$$

$$\tilde{W} = (w_1, w_2, w_3), \sum_{j=1}^n w_j = 1$$

where:

O_i is alternative i , i.e., $i(1,2,3, \dots, m)$

C_j indicates the indicators j , i.e., $j = (1,2,3, \dots, n)$

$\tilde{p}_{ij}$ is the performance of these options using fuzzy rating O_i based on indicators C_j

$\tilde{W}_j$ is the fuzzy weight allocated for all indicators. Hence, the triangular fuzzy number TFN can be written as follows $\tilde{p}_{ij} = (x_{ij}, y_{ij}, z_{ij})$.

Step 2. All benefit criterion values $\tilde{p}_i^+ = (x_i^+, y_i^+, z_i^+)$ and cost criterion values $\tilde{p}_i^- = (x_i^-, y_i^-, z_i^-)$ are calculated. The benefit criterion set is indicated as l^b , while l^c represents the cost criterion set as follows:

$$\tilde{p}_i^+ = \max_j \tilde{p}_{ij}, \quad \tilde{p}_i^- = \min_j \tilde{p}_{ij} \quad \text{for} \quad i \in l^b \quad \dots(9)$$

$$\tilde{p}_i^+ = \min_j \tilde{p}_{ij}, \quad \tilde{p}_i^- = \max_j \tilde{p}_{ij} \quad \text{for} \quad i \in l^c$$

Step 3. The values of the normalized fuzzy decision matrix $\tilde{D}_{ij}$ are as follows:

$$\tilde{D}_{ij} = \frac{\tilde{p}_i^+(-)\tilde{p}_{ij}}{z_i^+ - l_i^-} \quad \text{for} \quad i \in l^b \quad \dots(10)$$

$$\tilde{D}_{ij} = \frac{\tilde{p}_{ij}(-)\tilde{p}_i^+}{z_i^- - l_i^+} \quad \text{for} \quad i \in l^c.$$

Step 4. Compute $\tilde{S}_j = (\tilde{S}_j^x, \tilde{S}_j^y, \tilde{S}_j^z)$ and $\tilde{R}_j = (\tilde{R}_j^x, \tilde{R}_j^y, \tilde{R}_j^z)$ values:

$$\tilde{S}_j = \sum_{i=1}^n \tilde{W}_i(\times) \tilde{D}_{ij} \quad \dots(11)$$

$$\tilde{R}_j = \max_i \tilde{W}_i(\times) \tilde{D}_{ij} \quad \dots(12)$$

Step 5. Compute $\tilde{Q}_j = (\tilde{Q}_j^x, \tilde{Q}_j^y, \tilde{Q}_j^z)$ values :

$$\tilde{Q}_j = v \frac{\tilde{S}_j(-)\tilde{S}^+}{S^{-z} - S^{+x}} (+)(1 - v) \frac{\tilde{R}_j(-)\tilde{R}^+}{R^{-z} - R^{+x}} \quad \dots(13)$$

here $\tilde{S}^+ = \min_j \tilde{S}_j$; $S^{-z} = \max_j S_j^z$; $\tilde{R}^+ = \min_j \tilde{R}_j$; $R^{-z} = \max_j R_j^z$

Additionally, v is a combined strategy weight for most $\tilde{S}_j$ criteria, where $(1 - v)$ is the individual percentage of $\tilde{R}_j$.

Step 6 & step 7. The fuzzy $\tilde{S}_j$, $\tilde{R}_j$ and $\tilde{Q}_j$ values are converted into crisp and precise values. These crisp values rank the alternatives in descending order, and the findings are three ranked results: $\{O\}_S$, $\{O\}_R$ and $\{O\}_Q$.

Step 8. To meet the two conditions explained below, we propose a solution to the alternative $O^{(1)}$ that is considered the ideal solution of the measure Q :

Condition 1: Optimal benefit: *Ben is greater or equal to $\geq DQ$*

where $ben = \frac{[Q(O^{(2)}) - Q(O^{(1)})]}{[Q(O^{(m)}) - Q(O^{(1)})]}$ is the benefit rate of alternative $O^{(1)}$, which is ranked first compared

with the alternative that is ranked second $O^{(2)}$ in $\{O\}_Q$ and the threshold $DQ = \frac{1}{(m-1)}$

Condition 2: Decision-making stability:

Alternative $O^{(1)}$ must be ranked by S or Q values. Both conditions should be satisfied or at least one. If both conditions remain unmet, then a set of possible solutions is proposed, which can be explained as follows:

Condition satisfied 1: If only (COND2) is not satisfied, alternative $O^{(1)}$ and $O^{(2)}$ or:

The condition satisfies 2: if (COND1) is not satisfied, alternative $O^{(1)}, O^{(2)}, \dots, O^{(M)}$, where $O^{(m)}$ is defined by the following equation:

$$\frac{[Q(O^{(M)}) - Q(O^{(1)})]}{[Q(O^{(m)}) - Q(O^{(1)})]} < DQ \text{ for maximum } M. \quad \dots(14)$$

The alternative's locations are close to each other.

In this study, by applying the above FVIKOR steps, we evaluated each strategic alternative against the criteria and obtained a ranking of strategies from most to least preferred. The integrated FAHP–FVIKOR approach provides a reliable decision-support tool for strategic planning under uncertainty: the rankings of the top strategies remained stable even when varying certain fuzzy parameters in a sensitivity check, indicating the robustness of the results. Through the FVIKOR results, we identified a clear prioritization of green growth strategies for Morocco. This integrated methodology enables us to connect the weighted sustainability factors with actionable strategy choices. Figure 2 illustrates the overall methodological framework employed in this study.

The methodology used in this study to evaluate factors and develop strategies for the promotion of green growth in Morocco via both the FAHP and FVIKOR is a detailed and comprehensive approach that can help in determining key factors and subfactors and analyze their interconnections in order to propose recommendations for enhancing Morocco's sustainable performance.

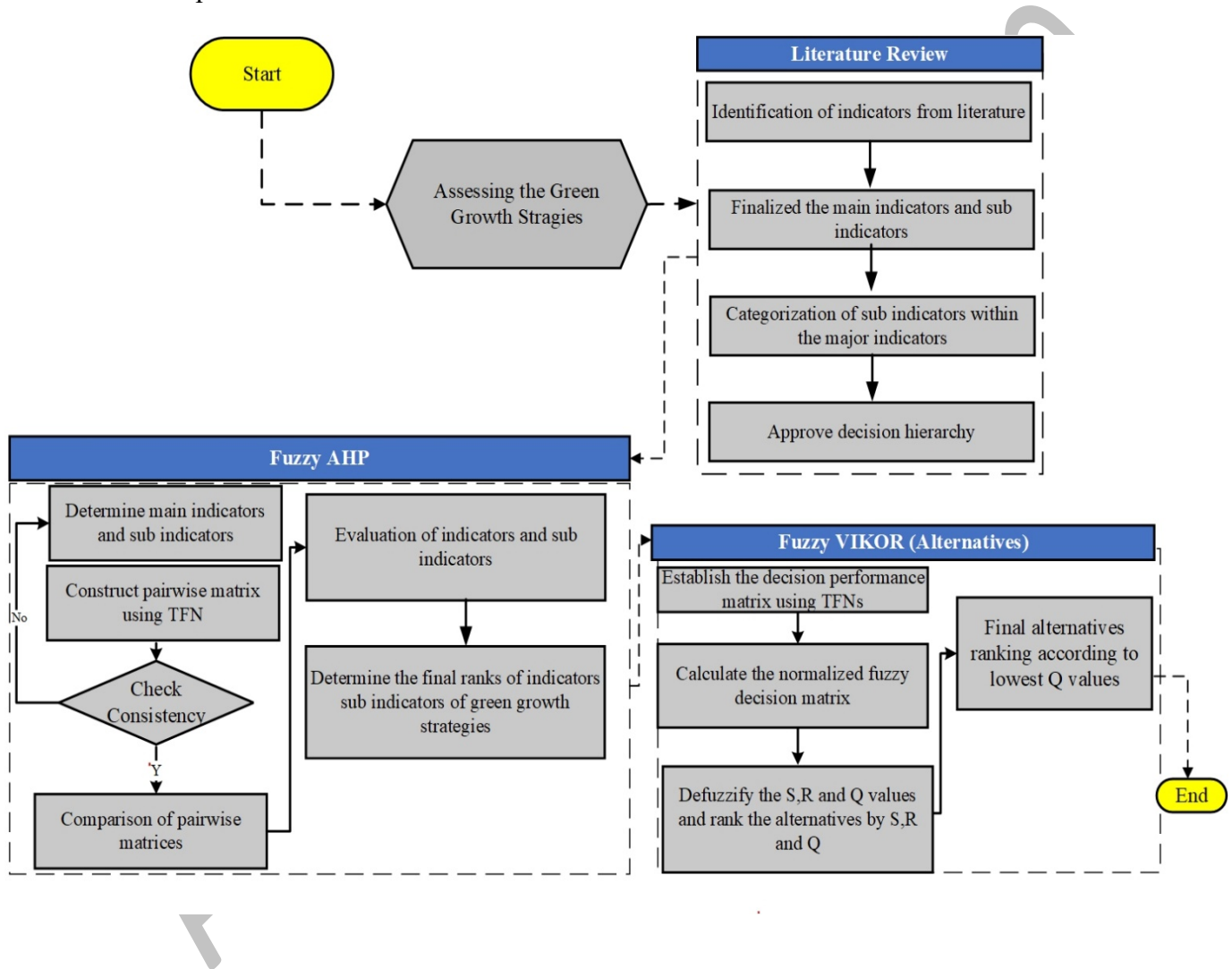


Figure 2: Integrated methodological framework for green growth.

3.3. Data collection

This study involved seven experts who participated in a questionnaire survey to evaluate the development of green growth strategies in Morocco. The details of green growth strategies are

presented in DataS1. Determining the precise number of experts needed for this research is complex; prior studies have used a range of sample sizes to achieve reliable results. For example, Meng and Shaikh (2023) employed five experts to evaluate ESG factors and proposed investment policies for green finance using FAHP and fuzzy WASPAS, whereas Alyamani et al. (2024) engaged nine experts to assess renewable energy strategies in Saudi Arabia. The participants in this study were chosen from a variety of backgrounds, including ESG and CSR managers, sustainability consultants and analysts, and university professors specializing in sustainability research. All selected experts had substantial professional experience (over ten years on average) in fields related to sustainable development or green finance, ensuring they possessed the requisite expertise. The respondents' identities were kept confidential. Experts were invited to provide judgments based on their subjective expertise via a web-based survey. The data collection process was completed within a set timeframe and included cross-validation checks for consistency. While the input of seven experts provides valuable insights, we acknowledge that this sample size may not capture all perspectives; accordingly, results should be interpreted with caution regarding broader generalizability. This study's findings are grounded in expert knowledge and illustrate the development of green growth strategies in Morocco.

4. Results

In this paper, the FAHP and FVIKOR methods were used to evaluate and rank the environmental, social, governance, financial variability and technological innovation factors for developing green growth strategies for Morocco. The FAHP method was adopted to assess and rank the main factors and subfactors; the results are presented in the following subsections.

4.1. Fuzzy AHP main factors

The FAHP includes two sections. The weights are allocated to the primary factors for green growth, and the second section contains the weights allocated to the subfactors of the main factors.

The rankings of the key factors for green growth are displayed in Table 3.

Table 3: Rankings of the main factors for green growth

Code	Main Factor	Weight	Rank
ENV	Environmental	0.3725	1 st
SOC	Social	0.1264	4 th
GOV	Governance	0.2249	2 nd
FINV	Financial variability	0.0952	5 th
TCHI	Technological innovation	0.1810	3 rd

Table 3 presents the weight allocated to each key factor computed via the fuzzy AHP method. Among the five main factors, the environmental factor (ENV) was ranked first, with the highest weight of 37.25%, making it the most significant. The governance factor (GOV) was ranked second, with a weight of 22.49%, followed by technological innovation (TCHI), with a weight of 18.10%; fourth, the social factor (SOC), with a weight of 12.64%; and finally, the financial variability factor (FINV), with a percentage of 9.52%. The ranking of the environmental factors in the first rank can be justified on the basis of multiple environmental issues that Morocco is currently facing, such as water scarcity and soil and air pollution (Schill et., 2021).

Currently, environmental sustainability is the first priority of Morocco since it plays a crucial role in the country's plans, which aim to transition to a more sustainable economy, particularly in the renewable energy sector. Strong governance practices are important in making decision-making transparent and accountable in the context of green growth. Governance factors include issues related to accountability, transparency, and the alignment of the operations and practices of companies with sustainable development goals. GOV ranks second, as policymakers in Morocco

should consider the corporate governance structure of companies to promote sustainable practices. The technological innovation factor is ranked third and contains practices such as the adoption of innovative technologies to encourage the transition of Morocco toward green growth (Jiakui et al., 2022). The social and financial variability factors that are ranked last behind the first three factors are considered the least impactful among the main factors used in this study.

4.2. Fuzzy AHP subfactors

By applying expert inputs to assess each of the thirty-three green growth subfactors related to the five main factors used in this study. Figure 3 represents the green growth factors and their relative subfactors with their associated codes.

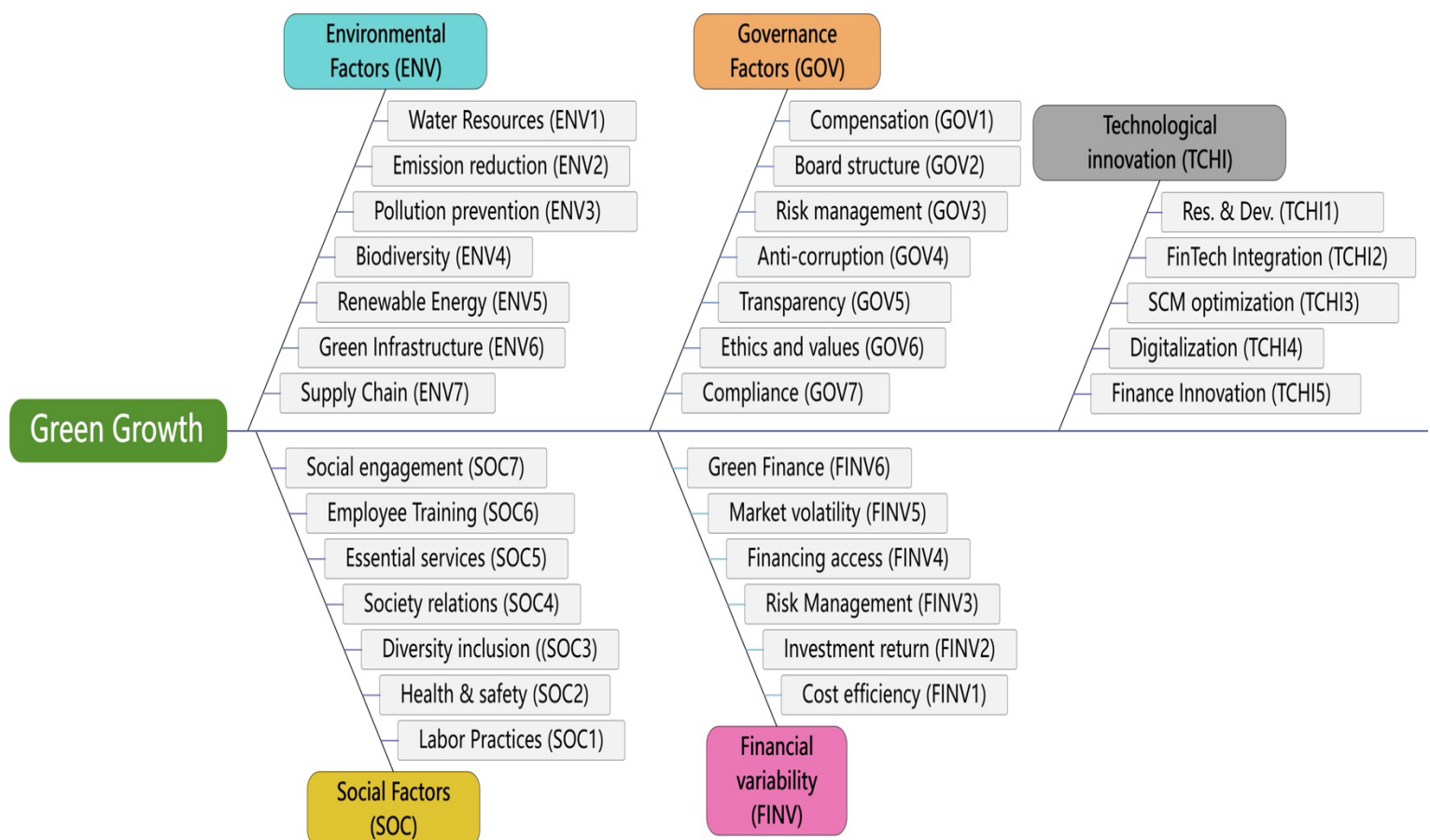


Figure 3: Green growth main indicators and subindicators

4.2.1. Results of the environmental subfactors (ENVs)

Figure 4 represents the overall ranking of the environmental subfactors on the basis of the results of the FAHP method. The ranking is organized in descending order by percentage, as shown in Figure 2: ENV2>ENV1>ENV4>ENV7>ENV6>ENV5>ENV3. where ENV2 represents carbon emission reduction and climate change with a weight of 29.2%, followed by the management of water resources ENV1 with a weight of 24.2%. Morocco has made addressing climate change and reducing greenhouse gas emissions among its highest priorities, with the aim of mobilizing USD 25 billion by 2030 for these purposes. Between 1995 and 2017, Morocco spent more than MAD 64.2 billion to help access clean drinking water in both rural and urban areas, and water scarcity is considered the main problem the country is facing and trying to address (Kaczmarek et al., 2023).

The third subfactor, ENV4 Conservation of biodiversity and responsible resource management, had a weight of 18.7%. Morocco is the second most biodiverse country in the Mediterranean; it represents high biological diversity with its complex assembly of ecosystems, species, and habitats. Sustainable supply chain management, which is ENV 7 with a percentage of 9%, followed by green infrastructure and green building, which represents ENV6 with a weight of 7.5%, are ranked fifth and sixth. These concepts are currently emerging in many countries, yet they are still new in the Moroccan context and need further integration within policy and practice for higher prioritization in green growth strategies. Renewable energy adoption and energy efficiency ENV5 and pollution prevention ENV3, with percentages of 6.4% and 5%, respectively, are considered the least impactful among the seven subfactors of the environmental sustainability factor.

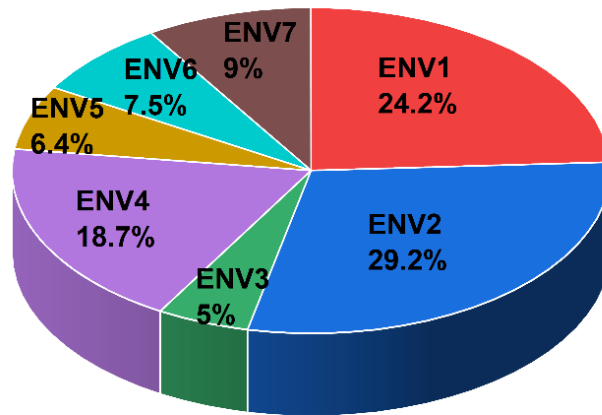


Figure 4: Rankings of the environmental subfactors

4.2.2. Results of social subfactors

Figure 5 represents the overall ranking of the social subfactors on the basis of the results of the FAHP method. The ranking is as follows: SOC5>SOC3>SOC6>SOC2>SOC4>SOC1>SOC7. Access to essential services (SOC5) is ranked first, with a percentage of 25.6%, and the country is currently focusing on healthcare and education, as they are considered moderately improving on the basis of the sustainable development report of 2024 (Sachs, Lafortune, & Fuller, 2024). This is followed by SOC3, which represents diversity and inclusion with a weight of 20.8%, which shows that Morocco should focus on developing diversity and inclusion within its strategies, a trend that has been gaining attention. Employee development and training (SOC6) is ranked third, accounting for 16%, indicating that the country should focus more on investing in employee development, especially with respect to sustainable practices. Both SOC2 and SOC4, which represent both health and safety and a company's community engagement and relationships, account for 11.1% and 6.3%, respectively, and are ranked fourth and fifth. This finding indicates that the company's engagement and relations factor is not as impactful as the first subfactors that are ranked in the first four places. For the least

impactful remaining subfactors, we have labor practices and human rights (SOC1) with a weight of 4.5% and social community engagement (SOC7) with only 3.9%.

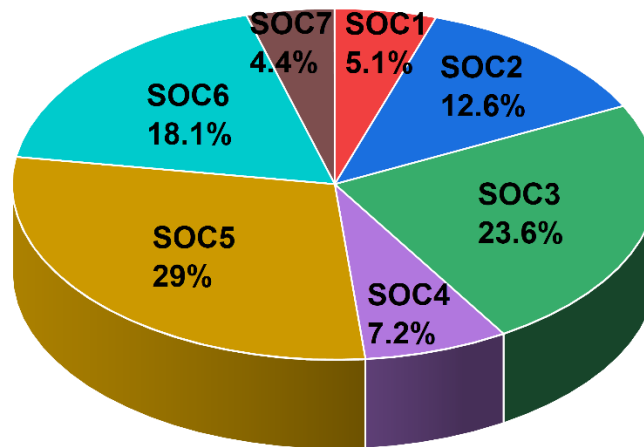


Figure 5: Rankings of the social subfactors

4.2.3. Results of governance subfactors

According to the findings of the FAHP analysis, the rankings of the governance subfactors are as follows: GOV4>GOV3>GOV6>GOV1>GOV2>GOV7>GOV5. Anti-corruption policies and measures (GOV4) have the highest rank, with a weight of 37%, which reflects that this subfactor is highly important. Addressing corruption and acting on its policies and practices should be the top priority of Morocco to transition toward green growth. The second-highest rank is risk management (GOV3), with a percentage of 24%, which means that Morocco should prioritize effective risk management practices to handle challenges related to the implementation of sustainable strategies and plans (Y. Li et al., 2023). Ethics and values (GOV6) are ranked third, with a weight of 12%, which indicates that ethical behavior is important for enhancing the country's sustainable development.

Moreover, if companies operate and behave ethically, there will be a great improvement in the country's sustainable performance. Executive compensation and accountability (GOV1), with

a weight of 11%, is ranked fourth, but board structure and composition (GOV2) is ranked fifth, with a percentage of 5.6%. The remaining subfactors are regulatory compliance (GOV7), with a percentage of 5.4%, and transparency and disclosure (GOV5), with a weight of 5.2%. The last three governance subfactors have weights that are close to each other at approximately 5%, which indicates that they are the least impactful among all subfactors. Figure 6 presents the rankings of the governance factors.

4.2.4. Results of financial variability subfactors

The rankings of the financial variability subfactors are as follows: $FINV2 > FINV6 > FINV1 > FINV4 > FINV5 > FINV3$, as presented in Figure 7. The return on investment represents $FINV2$ at a percentage of 29.1%, which is the most crucial subfactor among all the subfactors. This finding indicates that the return on investment generated from sustainable projects is crucial and has a large effect on the country's transition toward green growth. Green finance innovation ($FINV6$) is ranked second in importance, with a percentage of 22%, which indicates the importance of adopting green finance practices in Morocco. Cost efficiency ($FINV1$), with a percentage of 18.1%, is ranked third in importance, which shows that companies should focus more on managing their costs effectively. $FINV4$, which is financing access, is ranked fourth, with a percentage of 14.8%, which indicates that funding and financial support are crucial and can be supported by government initiatives. Market volatility ($FINV5$) and financial risk management ($FINV3$) are ranked last, with percentages of 8.4% and 7.7%, respectively, which means that they are the least impactful among all the financial variability subfactors.

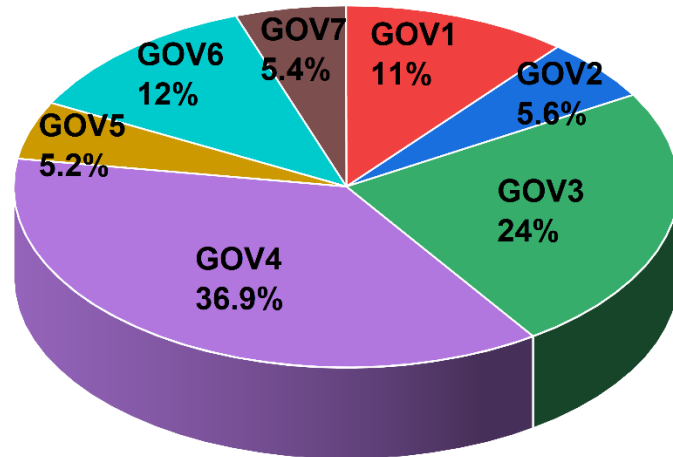


Figure 6: Rankings of the governance subfactors

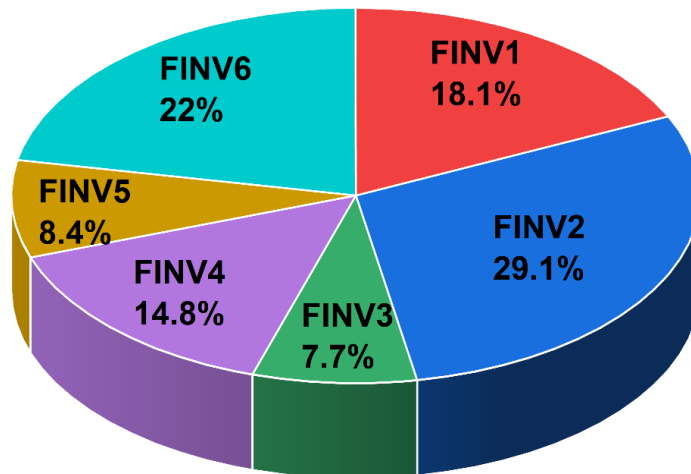


Figure 7: Rankings of the financial variability subfactors

4.2.5. Results of technological innovation subfactors:

Figure 8 displays the rankings of the technological innovation subfactors via the fuzzy AHP method. The rankings are as follows: TCHI4>TCHI5>TCHI3>TCHI1>TCHI2. These findings show that digitalization (TCHI4) is considered to be the most critical subfactor, with a weight of 27.5%, which indicates that it is important to encourage the utilization of advanced digital technologies that help enhance sustainability and operation efficacy. Innovative Financial

Instruments (TCHI5) is ranked second in importance, with a percentage of 23.7%, which suggests that this subfactor plays a large role in supporting Morocco's green growth through innovative financial resources that can support sustainable projects and initiatives. Supply chain optimization (TCHI3) is ranked third with a percentage of 20%, showing that it is not as important as digitalization and the adoption of innovative financial instruments. Research and development (TCHI1) is ranked fourth, with a weight of 16.3%, which suggests that R&D should be a priority to help support sustainable initiatives. Finally, we integrate fintech (TCHI2) with a percentage of 12.5%, which means that it is the least impactful among the prior subfactors.

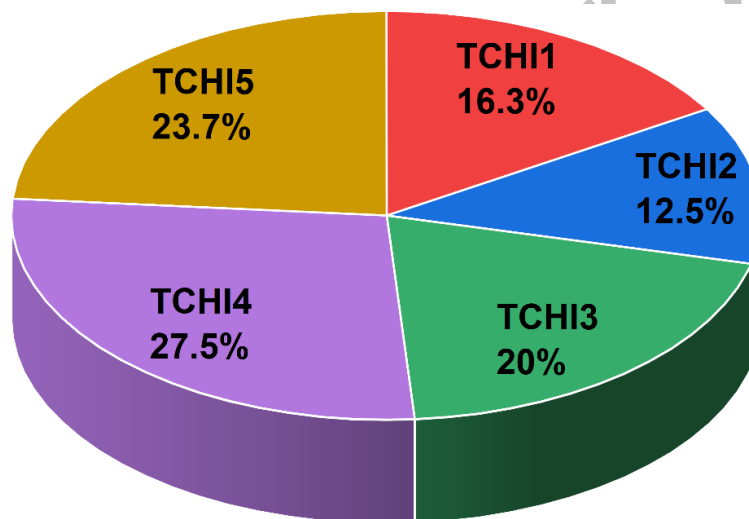


Figure 8: Rankings of the technological innovation subfactors

4.2.6. Final overall ranking

The final ranking of the subfactors is performed by multiplying the global weights of the subfactors by the weights of the related categories, as displayed in Table 4 and Figure 9. The final ranking of all the subfactors of this study is as follows: GOV5>SOC7>FINV5>GOV7>ENV6>SOC5>ENV7, FINV2>ENV3, GOV2, TCHI1>ENV1, ENV4, FINV6>GOV1>SOC4, GOV6,TCHI4>FINV1>SOC2,TCHI5>ENV2>FINV4>ENV5, GOV3, FINV3,TCHI3>SOC3, GOV4>TCHI2>SOC1>SOC6. The first rank is transparency and

disclosure (GOV5), with a percentage of 24.8%, the second highest rank is social community engagement (SOC7), with a percentage of 19.7%, market volatility (FINV5), with a weight of 19.6%, is positioned third, and the last rank is employee development and training (SOC6), with a weight of 0.2% . Moreover, All CR values were below 0.1, confirming acceptable consistency in the expert judgments.

Table 4: Final weights of subfactors

Main Factors	Main Factor Weights	Subfactors codes	Global Weight	Local weight
Environmental Factors	0.3725	ENV 1	0.0269	0.0156
		ENV 2	0.0682	0.0093
		ENV 3	0.0525	0.0174
		ENV 4	0.0430	0.0163
		ENV 5	0.0122	0.0062
		ENV 6	0.0102	0.0236
		ENV 7	0.0042	0.0199
Social Factors	0.1264	SOC 1	0.0622	0.0030
		SOC 2	0.0431	0.0102
		SOC 3	0.0508	0.0051
		SOC 4	0.0015	0.0136
		SOC 5	0.0696	0.0220
		SOC 6	0.0597	0.0019
		SOC 7	0.0152	0.1966
Governance Factors	0.2249	GOV 1	0.0130	0.0145
		GOV 2	0.0132	0.0165
		GOV 3	0.0218	0.0063
		GOV 4	0.0377	0.0047
		GOV 5	0.0310	0.2484
		GOV 6	0.0209	0.0139
		GOV 7	0.0439	0.0267
Financial Variability	0.0952	FINV 1	0.0100	0.0128
		FINV 2	0.0210	0.0197
		FINV 3	0.0263	0.0061
		FINV 4	0.0327	0.0072
		FINV 5	0.0563	0.1956
		FINV 6	0.0143	0.0163
Technological Innovation	0.1810	TCHI 1	0.0369	0.0165
		TCHI 2	0.0425	0.0037
		TCHI 3	0.0033	0.0062
		TCHI 4	0.0436	0.0140
		TCHI 5	0.0122	0.0101

(Note: Table 4 presents a detailed breakdown of the global weight (overall importance) and local weight (within-category importance) for each subfactor for each pairwise comparison matrix.)

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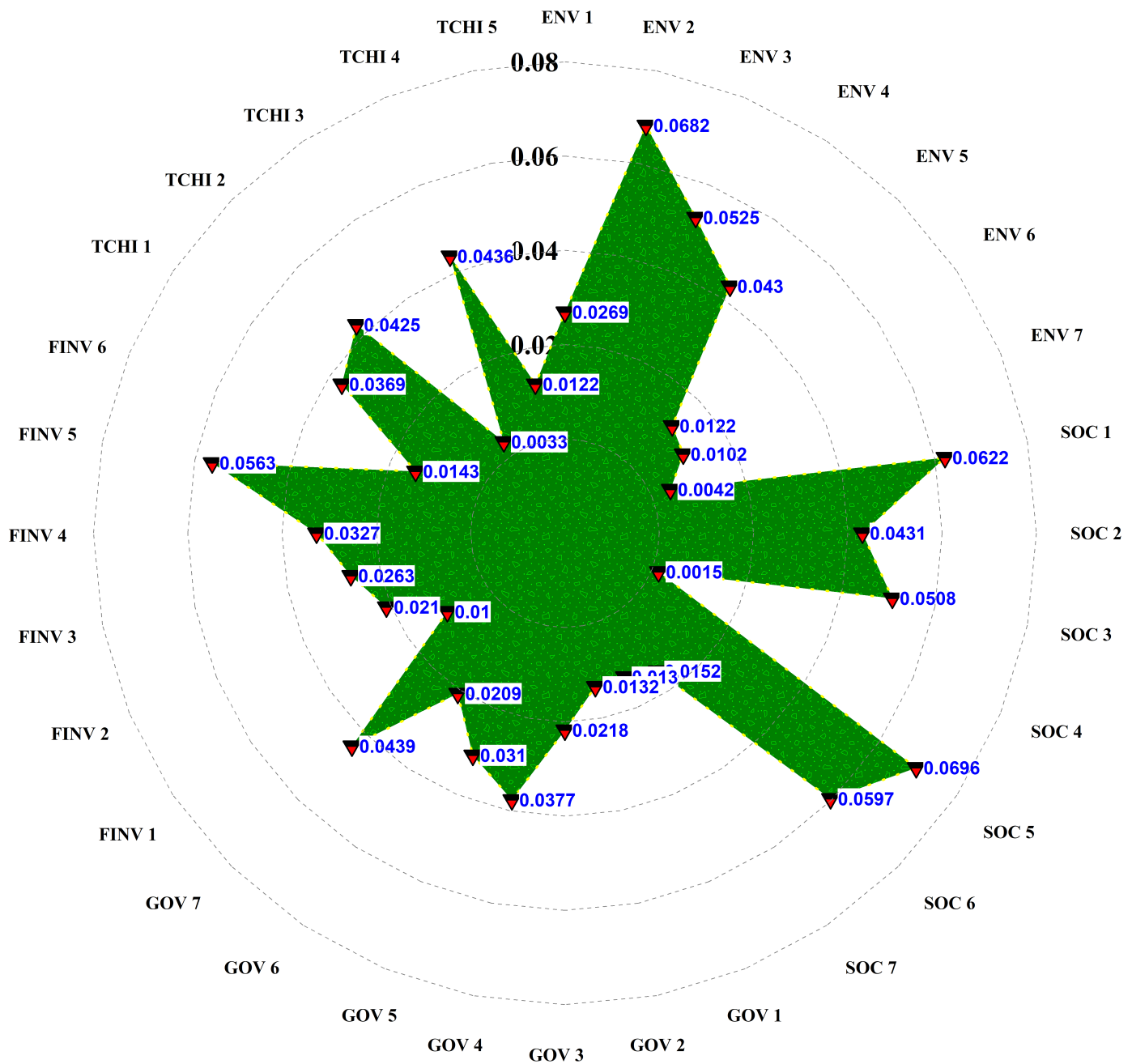


Figure 9: Ranking of all the green growth subindicators

4.3. Fuzzy VIKOR results

The FVIKOR method was used to assess and rank the green growth policies. Seven experts contributed to this analysis; a comprehensive decision-making methodology was used to determine the outcomes. We obtain the fuzzy decision matrix and the weighted normalized decision matrix

via the triangular fuzzy number rating scale after the comparison of the options against each subfactor. The evaluation process of green growth strategies is presented in figure 10. The green growth strategies that have the lowest Q_i values were prioritized as the most appropriate strategies for the promotion of green growth in Morocco. The S , R , and Q values are listed in Table 5.

Table 5: S, R, and Q values

Code	Green growth strategies	S_i	R_i	Q_i
S1	Green bonds issuing	0.0885	0.0188	0.0296
S2	Enhance transparency and disclosure	0.1713	0.0164	0.0267
S3	Encourage social responsibility and community engagement	0.1705	0.0201	0.0730
S4	Partnership with international partners	0.1572	0.0190	0.0842
S5	Shareholder Engagement	0.1465	0.0185	0.0407
S6	Government Support for FinTech	0.2564	0.2263	0.0711
S7	Technological Infrastructure Readiness	0.1699	0.0215	0.0675
S8	Support green finance innovation and development	0.1800	0.0254	0.0650
S9	Develop and enforce environmental regulations	0.1945	0.0225	0.0684

The green growth strategies are ranked on the basis of the lowest Q value, as shown in Table 6. Our results suggest that enhancing transparency and disclosure (S2) is considered the best green growth policy, with a weight of 2.7%, which focuses on the importance of prioritizing transparency and disclosure practices within Moroccan companies, especially with respect to the disclosure of sustainability performance. The second policy is (S1) green bond issuance, with a percentage of 2.97%, which aims to address the importance of green bonds in financing sustainable projects in Morocco. In third place, we have (S5) shareholder engagement, with a weight of 4.07%, and supporting green finance innovation (S8) is ranked fourth in importance, with a value of 6.50%, which focuses on encouraging the integration of innovative green finance instruments in promoting green growth initiatives in Morocco. Technological Infrastructure Readiness (S7) is ranked fifth in importance, with a percentage of 6.75%, Develop and enforce environmental regulations (S9) positioned 6th by obtaining 6.84% weight values, whereas Government Support for

FinTech (S6) received the weight value 7.11%. The remaining three strategies Encourage social responsibility and community engagement (S3) and Partnership with international partners (S4)

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are considered the least valuable among the nine strategies with the highest Q values of 7.30 %



and 8.42% respectively.

Figure 10: Green growth strategy evaluation process

These rankings simplify complex policy assessments into practical goals and can help guide policymakers to the most appropriate and effective strategies to support green growth and sustainability in Morocco.

Table 6: Prioritization of strategies for green growth according to the lowest Q values

Green growth strategies	Code	Qi	Rank
Enhance transparency and disclosure	S2	0.027	1st
Green bonds issuing	S1	0.031	2nd
Shareholder Engagement	S5	0.041	3rd
Support green finance innovation and development	S8	0.065	4th
Technological Infrastructure Readiness	S7	0.068	5th
Develop and enforce environmental regulations	S9	0.068	6th
Government Support for FinTech	S6	0.071	7th
Encourage social responsibility and community engagement	S3	0.073	8th
Partnership with international partners	S4	0.084	9th

4.4. Sensitivity Analysis

In this research, a sensitivity analysis was conducted to verify the reliability and robustness of the findings. The primary aim of the sensitivity assessment was to explore how alterations in the criteria weights influenced the ranking outcomes for green growth strategies associated with sustainable development. To examine these impacts, five distinct scenarios were created, each reflecting different conditions of uncertainty. The Fuzzy VIKOR results corresponding to each scenario are illustrated in table 7. Furthermore, Table 8 summarizes the prioritized rankings for green growth strategies, labeled from S1 to S9, as derived through the sensitivity analysis. The findings confirm that the rankings remain consistent throughout all tested scenarios, emphasizing the overall stability and reliability of the study's results.

Table 7: Weights of strategy with actual and different scenarios

Green Growth Strategy	Code	Current Scenario Weight	Scenario -1	Scenario -2	Scenario -3	Scenario-4	Scenario -5
Enhance transparency and disclosure	S2	0.027	0.027	0.028	0.027	0.026	0.027
Green bonds issuing	S1	0.030	0.029	0.029	0.029	0.029	0.03
Shareholder Engagement	S5	0.041	0.042	0.042	0.041	0.041	0.041
Support green finance	S8	0.065	0.065	0.066	0.065	0.064	0.065
innovation and development							
Technological Infrastructure Readiness	S7	0.068	0.067	0.068	0.068	0.067	0.068
Develop and enforce environmental regulations	S9	0.068	0.068	0.069	0.069	0.068	0.068
Government Support for FinTech	S6	0.071	0.072	0.072	0.071	0.072	0.071
Encourage social responsibility and community engagement	S3	0.073	0.073	0.073	0.073	0.075	0.073
Partnership with international partners	S4	0.084	0.086	0.086	0.082	0.085	0.084

Table 8: Final result of sensitivity analysis

Green Growth Strategy	Code	Current Scenario Weight	Scenario -1	Scenario -2	Scenario -3	Scenario-4	Scenario -5
Green bonds issuing	S1	2	2	2	2	2	2

Enhance transparency and disclosure	S2	1	1	1	1	1	1
Encourage social responsibility and community engagement	S3	8	8	8	8	8	8
Partnership with international partners	S4	9	9	9	9	9	9
Shareholder Engagement	S5	3	3	3	3	3	3
Government Support for FinTech	S6	7	7	7	7	7	7
Technological Infrastructure Readiness	S7	5	5	5	5	5	5
Support green finance innovation and development	S8	4	4	4	4	4	4
Develop and enforce environmental regulations	S9	6	6	6	6	6	6

5. Discussion and policy implications

The FAHP and fuzzy VIKOR methods provide crucial insights into prioritizing multiple aspects of Morocco's sustainable development. The research involved determining the main factors and subfactors for developing and accessing green growth strategies and using the fuzzy VIKOR technique to rank these strategies according to their performance against these factors. On the basis of the results of this paper, the most significant factors are governance, social, and financial variability factors, and the subfactors that were found to be the most significant are transparency and disclosure (GOV5), social community engagement (SOC7), and market volatility (FINV5). The results of the fuzzy VIKOR method show that enhancing transparency and

disclosure practices is very important (S2), and the results show that issuing green bonds (S1) and engaging with shareholders (S5) were the most significant green growth strategies. According to the results of this research, transparency and disclosure practices should be a top priority for developing sustainability and good governance in the country. Fostering these practices can help enhance trust and attract more foreign investors in the near future, which can help fund and support sustainable projects. Policymakers and financial institutions in Morocco should prioritize issuing green bonds since they are ranked second in importance in helping to promote green growth (Bhutta et al., 2021). Shareholder engagement is ranked third among the top three strategies for green growth since shareholders play a large role in promoting sustainability inside companies; shareholders in Morocco can help through filing proposals that aim to address sustainability issues and by voting in annual general meetings (Fiorillo & Santilli, 2024).

5.1. Theoretical implications

The theoretical implications of this paper include enhancing the understanding of how ESG environmental, social, and governance factors and green finance can help achieve green growth. The findings of this paper highlight the importance of ESG factors, especially the role of governance factors such as transparency and disclosure and shareholder involvement, in achieving green growth in the context of Morocco. The results of this paper highlight the importance of green innovative financial instruments in facilitating the achievement of green growth in Morocco through the issuance of green bonds. Our results strongly align with the theoretical framework that highlights the important role of ESG factors as well as green finance instruments such as green bonds in encouraging the promotion and adoption of green growth initiatives in Morocco.

The issuance of green bonds aligns with diffusion and innovation theory since they are considered crucial innovative financial tools in the context of green finance. These bonds comply

with ESG standards, help hedge climate risk and help finance renewable energy projects that are currently in action in the context of Morocco. According to the findings of this study, shareholder engagement is ranked third in terms of the best green growth strategies. This aligns with stakeholder theory, as shareholders are considered key stakeholders, and their support for sustainable projects is crucial. According to stakeholder theory, a company's success depends on its ability to create value to its stakeholders, not only for shareholders; since shareholders are part of this network, their support for sustainable projects and their efforts to ensure that sustainable practices operate according to the organization's core operations can be beneficial to the organization by enhancing its reputation, thereby improving its financial value.

5.2. Practical implications

The results of this research paper have significant practical implications for the country's efforts and initiatives to support green growth and enhance sustainability. According to the findings of this study, Morocco can enhance its sustainability performance and promote green growth by applying and integrating the green growth strategies developed in this research. Companies in Morocco should prioritize transparency and disclosure practices since they are crucial for improving governance, fostering trust and accountability and attracting foreign investors, who play a large role in funding sustainable projects. The Moroccan government should implement mandatory policies regarding transparency, especially with respect to the disclosure of the sustainable and ESG performance of companies. The government can offer subsidies or tax incentives to Moroccan companies to help meet high transparency standards.

Green bonds are considered useful innovative green financing instruments; however, issuing green bonds is not a widely practiced financing method. The country should encourage the issuance of these fixed-income securities since they solve an enormous issue faced by most

Moroccan companies, which is related to funding sustainable projects. Green bonds can provide companies with the financial support they need to promote green growth initiatives. The role of shareholders in encouraging green growth is very important, and shareholders in Moroccan companies can use their voting rights to support investments in sustainable projects such as renewable energy projects. The government of Morocco is currently launching a strategic plan to increase both the energy efficiency and the percentage of renewable energy in the energy mix, following the strategic plan of the European Commission's objective of reaching 32% renewable energy by 2030 (Cantoni & Rignall, 2019). Shareholders can help achieve this goal through their engagement and their impact on the company's sustainable performance. As key stakeholders, shareholders in Morocco can promote green growth through active communication with top management within companies through the integration of green initiatives into the strategic plan and business models of the company.

However, several implementation challenges could hinder these efforts. For example, the adoption of FinTech solutions to support green finance may face regulatory hurdles or limited digital infrastructure. Similarly, boosting active shareholder engagement may require stronger governance frameworks and cultural shifts in corporate practices. It is important that Moroccan policymakers address such barriers by updating financial and corporate governance regulations, improving technical capacity, and raising awareness among stakeholders to ensure the successful implementation of the recommended green growth strategies.

The analysis presented is specific to Morocco, but the integrated framework and findings can also inform sustainability efforts in other countries with similar economic and environmental contexts. Other nations in the MENA region, such as Tunisia or Egypt, face comparable green growth challenges and could adapt the identified factors and strategic priorities to their own policy-

making. Thus, the approach and insights from this study have broader applicability beyond Morocco's borders.

6. Conclusion

This study proposed an integrated strategic decision-making framework to evaluate green growth strategies that can help Morocco enhance its sustainable performance and promote green growth via both the FAHP and fuzzy VIKOR methods. The thirty-two green growth factors used in this research were divided into five main categories: environmental factors, social factors, governance factors, financial variability factors, and technological innovation factors. The FAHP method was used to allocate weights to the main factor and subfactor used in this research and to analyze each of these factors accordingly. The findings of this study show that governance and social as well as financial variability factors are considered the most significant main factors among the five factors. The most influential subfactors include transparency and disclosure (GOV5), with a weight of 24.8%; social community engagement (SOC7), with a weight of 19.7%; and market volatility (FINV5), with a percentage of 19.6%. In the context of Morocco, this study is one of the first studies to evaluate green growth factors for sustainable development.

This research provides significant insights by using the FVIKOR method to rank and prioritize the green growth strategies developed in this study. The results of the fuzzy VIKOR technique show that the key prioritized strategies are enhancing transparency and disclosure (S2) with a weight of 2.7%, issuing green bonds (S1) with a weight of 3.0%, and engaging shareholders (S5) with a percentage of 4.1%. These strategies are ranked in ascending order from smallest to largest, where the strategies with the smallest weights are considered the most impactful among the nine green growth strategies developed in this research, and those with the largest weights are the least impactful.

The first green growth policy focused on improving transparency and disclosure practices in Morocco to support the green growth practices of Moroccan companies. By implementing strict regulations regarding transparency, companies can disclose transparent environmental, social, and governance performance information as well as their overall sustainable performance, resulting in an increase in customer and foreign investor trust. If companies in Morocco are providing the government with transparent and clear information, policymakers in Morocco can track the country's sustainable progress and enhance its sustainable performance. The transparent disclosure of the sustainability performance of companies can help develop and refine strategies that aim at reaching green growth targets. Therefore, Morocco should prioritize fostering governance through the improvement of transparency. The second recommended policy for green growth in Morocco is encouraging the issuance of green bonds within the country. As an innovative green financial instrument, issuing green bonds can help raise capital that can substantially be used to fund sustainable projects.

These fixed-income securities are considered perfect tools for investors who want to support sustainable projects while generating returns. These bonds can promote a swift shift toward a green economy through financing large projects in different fields, such as renewable energy, and initiatives that aim to decrease greenhouse gas emissions and mitigate climate change. Since funding for green growth projects and maintaining a fixed income without impacting a company's operations are considered the main obstacles for companies in Morocco, green bonds can serve as a solution to this issue. The first time Morocco issued green bonds was in 2016 by the Moroccan Agency for Solar Energy (MASEN) to support and fund solar energy projects under the Noor initiative. In accordance with the findings of this study, we encourage Morocco to use these green finance tools to support sustainable projects for a green future.

The third recommended policy focuses on shareholder engagement in promoting green growth in Morocco. Shareholders have considerable influence on an organization's operations, decision-making and strategies. The engagement of shareholders can be accomplished through voting for more sustainable initiatives, pushing companies to integrate green growth strategies into how they operate, such as reducing their carbon footprint and adopting renewable energy. Shareholders can drive significant change in the context of green growth by monitoring the company's sustainability performance and holding these companies responsible for not meeting the sustainability standards; in this case, shareholders in Morocco should be in the position of catalysts, and their active engagement should transform the company's strategies and direction toward a green future. These policy recommendations help Morocco shift to a more sustainable and green economy.

Collectively, implementing these strategies will directly support Morocco's sustainable development objectives. For instance, improving transparency and governance (our top strategy) contributes to building strong institutions (SDG 16: Peace, Justice, and Strong Institutions), while issuing green bonds provides financing for climate action and sustainable cities (SDG 13: Climate Action and SDG 11: Sustainable Cities and Communities). Likewise, prioritizing environmental disclosure and stakeholder engagement aids the protection of terrestrial ecosystems (SDG 15: Life on Land) by fostering accountability and community involvement. By aligning our recommendations with these global goals, this work demonstrates how Morocco can leverage green growth initiatives to enhance its overall SDG performance.

This research has several areas that could be improvement or explored in future research. First, the study focuses solely on Morocco; applying the framework to other regions (e.g., other MENA countries or developing economies) would test its generalizability. Second, we used a specific set of green growth factors relevant to Morocco; future studies could consider additional factors or

sector-specific factors in different contexts. Third, while expert input was crucial, it can be influenced by personal biases. We used a structured survey to obtain results, but other methods such as broader stakeholder workshops or interviews could be used in the future to validate and enrich the findings. Finally, a more extensive sensitivity analysis could be performed on the fuzzy decision model to explore the stability of outcomes under varying assumptions. While these limitations are acknowledged, the insights and opportunities for future research remain significant

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Supplementary file

Toward Green Growth in Morocco: An Integrated Strategic Decision-Making Framework for Sustainable Development

Thank you for participating in our comprehensive survey designed to gather expert insights on the role of Environmental, Social, and Governance (ESG) criteria, green finance, and green technology initiatives in promoting sustainability and green growth in Morocco. Your input is invaluable as we aim to understand the various factors influencing sustainable development and environmental innovation in the country. Please provide thoughtful responses based on your expertise and experience. The information you provide will contribute to shaping critical discussions and policy decisions in the realm of sustainable development.

Section 1. Survey Questionnaire

Demographic Information

Gender:

Age:

Experience in Current Position:

Academic Background.....

Current Professional Status:

Company type:

Section 2: Main Indicators and Sub-Indicators of green growth ranking

The main indicators and sub-indicators of green growth of this research are listed below.

Criteria	Sub-criteria	Description
Environmental Factors (ENV)	Management of water resources (ENV1)	The practices that companies do to manage their natural resources including water, it focuses on how companies use these water resources and, on their conservation.
	Carbon emission reduction and climate change (ENV2)	Organization's carbon footprint, and the investments made to lower greenhouse gas emissions and its impact on the environment and climate change.
	Pollution prevention (ENV3)	The practices taken by companies to address pollution in air, soil, and water. It focuses on how the company

		handles waste and whether it respects environmental laws and regulations.
	Conservation of biodiversity and responsible resource management (ENV4)	The organization's efforts dedicated to protecting biodiversity. It takes into consideration how the company preserve resources such as forests.
	Renewable energy adoption and energy efficiency (ENV5)	Assessing the company's efforts in supporting renewable energy initiatives such as solar energy and wind energy projects financially (investments), technically (technology usage), and logistically,
	Green infrastructure and green building (ENV6)	The usage of eco-friendly materials in construction, it evaluates how committed the company to green building and construction by constructing green roofs for example that meets the standards of sustainable construction such as LEED (Leadership in Energy and Environmental Design).
	Sustainable supply chain management (ENV7)	How committed are organizations to integrate sustainable practices into their supply chain operations like partnership with suppliers to use eco - friendly materials and help diminishing transportation emissions.
Social factors (SOC)	Labor Practices and human rights (SOC1)	How the company treats it employees, and deals issues such as child labor and forced labor.
	Health and safety (SOC2)	How committed the company is to the safety and wellbeing of its employees is evaluated by examining how safe the internal work environment is.
	Diversity and inclusion (SOC3)	The company's commitment to provide equal opportunities as well as the policies implemented by the company with regard to diversity in terms of age, gender and ethnic groups.
	Company's community engagement and relations (SOC4)	Relationship the company and its community have; it takes into consideration the company's interactions with the community where it operates and how they impact the local development of the economy.
	Access to essential services (SOC5)	The organization's impact on the ability of communities to access crucial services such as education and healthcare. It considers the commitment of the company to support social welfare by supporting educational programs for example.
	Employee Development and Training (SOC6)	The company's efforts that are put to train and develop its workforce is evaluated in this subfactor such as investments made for the purpose of training and shaping the work force skills to align with the company's economic and sustainable goals.
	Social Community engagement	The level of community's engagement in the development and implementation of green growth

	(SOC7)	practices and the impact of these communities on the execution of these policies and practices.
Governance factors (GOV)	Executive compensation and accountability (GOV1)	The policies the company follows with regard to the compensation of executives. It takes into account how executives are responsible to shareholders and how their compensation aligns with the company's main purpose.
	Board structure and composition (GOV2)	The board of directors' accountability and responsibility and on the practices the company follows with regard to their compensation, it also focuses on the BOD (board of directors) diversity, and responsibility.
	Risk management (GOV3)	How companies manage different levels of risks related to environmental, economic, and social aspects. Companies with efficient risk management practices can predict and minimize risks better.
	Anti-corruption policies and measures (GOV4)	Anti-corruption procedures and policies implemented by companies; It evaluates how committed are to addressing corruption.
	Transparency and disclosure (GOV5)	The organization's practices regarding transparency and disclosure, evaluating how accurately the company reports its performance and how committed it is to be providing transparent information.
	Ethics and values (GOV6)	The company's ethical behavior- whether it operates ethically and how its practices impact the economy and the environment.
	Regulatory compliance (GOV7)	The company's compliance with regulations and laws that are related to sustainability and social issues.
Financial variability (FINV)	Cost efficiency (FINV1)	Evaluating cost saving practices implemented by companies that invest in sustainable projects and whether they operate at lower costs efficiently.
	Return on investment (ROI) (FINV2)	The long term and short-term return on investment of projects implemented by companies to promote sustainability and green growth.
	Financial Risk management (FINV3)	Practices by companies to manage financial risk that could affect the progress of green growth. A stable financial framework that supports sustainable initiatives is crucial for green growth
	Financing access (FINV4)	How companies gain access to financial support (e.g., loans) to fund sustainable projects.
	Market volatility (FINV5)	Market volatility and fluctuation can significantly impact investments decision and financial stability.
	Green Finance Innovations (FINV6)	Innovative practices that companies use in the context of green finance to promote green growth.
Technological innovation (TCHI)	Research and development (TCHI1)	The company's involvement in R&D, and how committed it is to be improving R&D practices that

	help in develop innovative sustainable products and services.
Integration of FinTech (TCHI2)	The important role of financial technology in promoting sustainable practices, including it helps track sustainability metrics and promote green finance practices.
Supply chain optimization (TCHI3)	The company's initiatives in lowering carbon footprints through sustainable supply chain practices.
Digitalization (TCHI4)	The integration of digital technologies and data analytics in the context of sustainable financial practices.
Innovative Financial Instruments (TCHI5)	Efforts done by companies to develop and implement cutting edge financial instruments (e.g., crowdfunding) that help raise money for sustainable projects.

Section-3: Answering Instruction

Instruction 1: For each pair of main indicators, please rate the importance of one indicator relative to the other using a scale from 1 to 5, where 1 means that both indicators are equally important, and higher ratings indicate a preference for one indicator being more important than the other. Please specify your preference clearly.

Scale of importance 1 to 5 for indicators and sub-indicators

Code	Linguistic Variable	Triangular fuzzy Numbers
1	Equal Important	(1,1,3)
2	Moderate Important	(1,3,5)
3	Strong Important	(3,5,7)
4	Very strong Important	(5,7,9)
5	Extreme Important	(7,9,11)

Instruction No. 2:

You need to consider relative importance of Indicator's and score any one Indicators in the respective blank space (either left or right) in the questionnaire. Here are a few examples to help you complete this questionnaire.

Example #1: Please rate the importance of one indicator (ENV) to another Indicator (SOC). In this case, you have to employ your judgment to enter a score (1-5) in any blank space according to the previous description.

For instance, if you believe SOC B2 is extreme important than ENVB1, you must enter the score in the empty spot on the right.

Main indicator	Score 1-5		Main indicator
Environmental (ENV)		5	Social (SOC)

Accordingly, you consider the SOC indicator as being extremely important in comparison to the ENV indicator.

Example #2: Please assign an importance to sub-indicator ENV1 and ENV2.

Sub-indicator	Score 1-5		Sub-indicator
Management of water resources (ENV1)	2		Carbon emission reduction and climate change (ENV2)

Accordingly, you consider the sub-indicator ENV1 as being moderate important in comparison to the sub-indicator ENV2.

Part A: Main Indicators

A questionnaire survey concerning the green growth indicators to Morocco's toward sustainable development.

Please rate the importance of the main barrier against each barrier using a scale from 1 to 5.

Main Indicator	Score (1–5)		Main Indicator
Environmental (ENV)			Social (SOC)
Environmental (ENV)			Governance (GOV)
Environmental (ENV)			Financial variability (FINV)
Environmental (ENV)			Technological innovation (TCHI)
Social (SOC)			Governance (GOV)
Social (SOC)			Financial variability (FINV)
Social (SOC)			Technological innovation (TCHI)
Governance (GOV)			Financial variability (FINV)
Governance (GOV)			Technological innovation (TCHI)
Financial variability (FINV)			Technological innovation (TCHI)

Part B: Sub-Indicators

Instructions: For each pair of green growth sub-indicators, please rate the importance of one sub-indicators relative to the other using a scale from 1 to 5, where 1 means that both indicators are equally important, and higher ratings indicate a preference for one indicator being more important than the other. Please specify your preference clearly.

Determining Sub-indicators for the green growth in Morocco.

1. Please rate the importance of Sub-barriers (ENV1–ENV7) against each Sub-indicators (ENV1–ENV7) relating to Environmental Indicator (ENV) using a scale from 1 to 5.

Sub-Indicator (Environmental)	Score (1–5)		Sub-Indicator (Environmental)
Management of water resources (ENV1)			Carbon emission reduction and climate change (ENV2)
Management of water resources (ENV1)			Pollution prevention (ENV3)
Management of water resources (ENV1)			Conservation of biodiversity and responsible resource management (ENV4)
Management of water resources (ENV1)			Renewable energy adoption and energy efficiency (ENV5)
Management of water resources (ENV1)			Green infrastructure and green building (ENV6)
Management of water resources (ENV1)			Sustainable supply chain management (ENV7)
Carbon emission reduction and climate change (ENV2)			Pollution prevention (ENV3)
Carbon emission reduction and climate change (ENV2)			Conservation of biodiversity and responsible resource management (ENV4)
Carbon emission reduction and climate change (ENV2)			Renewable energy adoption and energy efficiency (ENV5)
Carbon emission reduction and climate change (ENV2)			Green infrastructure and green building (ENV6)
Carbon emission reduction and climate change (ENV2)			Sustainable supply chain management (ENV7)
Pollution prevention (ENV3)			Conservation of biodiversity and responsible resource management (ENV4)
Pollution prevention (ENV3)			Renewable energy adoption and energy efficiency

			(ENV5)
Pollution prevention (ENV3)			Green infrastructure and green building (ENV6)
Pollution prevention (ENV3)			Sustainable supply chain management (ENV7)
Conservation of biodiversity and responsible resource management (ENV4)			Renewable energy adoption and energy efficiency (ENV5)
Conservation of biodiversity and responsible resource management (ENV4)			Green infrastructure and green building (ENV6)
Conservation of biodiversity and responsible resource management (ENV4)			Sustainable supply chain management (ENV7)
Renewable energy adoption and energy efficiency (ENV5)			Green infrastructure and green building (ENV6)
Renewable energy adoption and energy efficiency (ENV5)			Sustainable supply chain management (ENV7)
Green infrastructure and green building (ENV6)			Sustainable supply chain management (ENV7)

2. Please rate the importance of Sub-indicators (SOC1–SOC7) against each Sub-indicators (SOC1–SOC7) relating to Social Indicators (B2) using a scale from 1 to 5.

Sub-Indicator (Social)	Score (1–5)	Sub-Indicator (Social)
Labor Practices and human rights (SOC1)		Health and safety (SOC2)
Labor Practices and human rights (SOC1)		Diversity and inclusion (SOC3)
Labor Practices and human rights (SOC1)		Company's community engagement and relations (SOC4)
Labor Practices and human rights (SOC1)		Access to essential services (SOC5)
Labor Practices and human rights (SOC1)		Employee Development and Training (SOC6)
Labor Practices and human rights (SOC1)		Social Community engagement (SOC7)
Health and safety (SOC2)		Diversity and inclusion (SOC3)
Health and safety (SOC2)		Company's community engagement and relations (SOC4)
Health and safety (SOC2)		Access to essential services (SOC5)
Health and safety		Employee Development and Training

(SOC2)			(SOC6)
Health and safety (SOC2)			Social Community engagement (SOC7)
Diversity and inclusion (SOC3)			Company's community engagement and relations (SOC4)
Diversity and inclusion (SOC3)			Access to essential services (SOC5)
Diversity and inclusion (SOC3)			Employee Development and Training (SOC6)
Diversity and inclusion (SOC3)			Social Community engagement (SOC7)
Company's community engagement and relations (SOC4)			Access to essential services (SOC5)
Company's community engagement and relations (SOC4)			Employee Development and Training (SOC6)
Company's community engagement and relations (SOC4)			Social Community engagement (SOC7)
Access to essential services (SOC5)			Employee Development and Training (SOC6)
Access to essential services (SOC5)			Social Community engagement (SOC7)
Employee Development and Training (SOC6)			Social Community engagement (SOC7)

3. Please rate the importance of Sub-indicators (GOV1-GOV7) against each Sub-indicators (GOV1-GOV7) relating to Governance Indicators (GOV) using a scale from 1 to 5.

Sub-Indicator (Social)	Score (1–5)		Sub-Indicator (Social)
Executive compensation and accountability (GOV1)			Board structure and composition (GOV2)
Executive compensation and accountability (GOV1)			Risk management (GOV3)
Executive compensation and accountability (GOV1)			Anti-corruption policies and measures (GOV4)
Executive compensation and accountability (GOV1)			Transparency and disclosure (GOV5)
Executive compensation and accountability (GOV1)			Ethics and values (GOV6)
Executive compensation and accountability (GOV1)			Regulatory compliance (GOV7)
Board structure and composition (GOV2)			Risk management (GOV3)

Board structure and composition (GOV2)			Anti-corruption policies and measures (GOV4)
Board structure and composition (GOV2)			Transparency and disclosure (GOV5)
Board structure and composition (GOV2)			Ethics and values (GOV6)
Board structure and composition (GOV2)			Regulatory compliance (GOV7)
Risk management (GOV3)			Anti-corruption policies and measures (GOV4)
Risk management (GOV3)			Transparency and disclosure (GOV5)
Risk management (GOV3)			Ethics and values (GOV6)
Risk management (GOV3)			Regulatory compliance (GOV7)
Anti-corruption policies and measures (GOV4)			Transparency and disclosure (GOV5)
Anti-corruption policies and measures (GOV4)			Ethics and values (GOV6)
Anti-corruption policies and measures (GOV4)			Regulatory compliance (GOV7)
Transparency and disclosure (GOV5)			Ethics and values (GOV6)
Transparency and disclosure (GOV5)			Regulatory compliance (GOV7)
Ethics and values (GOV6)			Regulatory compliance (GOV7)

4. Please rate the importance of Sub-indicators (FINV1- FINV6) against each Sub-indicators (FINV1- FINV6) relating to Financial Variability Indicators (FINV) using a scale from 1 to 5.

Sub-Indicator (Social)	Score (1–5)		Sub-Indicator (Social)
Cost efficiency (FINV1)			Return on investment (ROI) (FINV2)
Cost efficiency (FINV1)			Financial Risk management (FINV3)
Cost efficiency (FINV1)			Financing access (FINV4)
Cost efficiency (FINV1)			Market volatility (FINV5)
Cost efficiency (FINV1)			Green Finance Innovations (FINV6)
Return on investment (ROI) (FINV2)			Financial Risk management (FINV3)

Return on investment (ROI) (FINV2)			Financing access (FINV4)
Return on investment (ROI) (FINV2)			Market volatility (FINV5)
Return on investment (ROI) (FINV2)			Green Finance Innovations (FINV6)
Financial Risk management (FINV3)			Financing access (FINV4)
Financial Risk management (FINV3)			Market volatility (FINV5)
Financial Risk management (FINV3)			Green Finance Innovations (FINV6)
Financing access (FINV4)			Market volatility (FINV5)
Financing access (FINV4)			Green Finance Innovations (FINV6)
Market volatility (FINV5)			Green Finance Innovations (FINV6)

5. Please rate the importance of Sub-indicators (TCHI1- TCHI5) against each Sub-indicators (TCHI1- TCHI5) relating to Technological Innovation Indicators (TCHI) using a scale from 1 to 5.

Sub-Indicator (Social)	Score (1–5)		Sub-Indicator (Social)
Research and development (TCHI1)			Integration of FinTech (TCHI2)
Research and development (TCHI1)			Supply chain optimization (TCHI3)
Research and development (TCHI1)			Digitalization (TCHI4)
Research and development (TCHI1)			Innovative Financial Instruments (TCHI5)
Integration of FinTech (TCHI2)			Supply chain optimization (TCHI3)
Integration of FinTech (TCHI2)			Digitalization (TCHI4)
Integration of FinTech (TCHI2)			Innovative Financial Instruments (TCHI5)
Supply chain optimization (TCHI3)			Digitalization (TCHI4)
Supply chain optimization (TCHI3)			Innovative Financial Instruments (TCHI5)
Digitalization (TCHI4)			Innovative Financial Instruments (TCHI5)

Accepted version

Part C: Green Growth Strategies towards Sustainable Development in Morocco

Section C: Please rate the importance of various solution strategies with respect to all sub-indicators using a scale from 1 to 5.

Scale of importance for solution strategies

Code	Linguistic Variable	Triangular fuzzy Numbers
1	Equal Important	(1,1,3)
2	Moderate Important	(1,3,5)
3	Strong Important	(3,5,7)
4	Very strong Important	(5,7,9)
5	Extreme Important	(7,9,11)

Green growth strategic solutions towards sustainable development

Code	Strategic Solution	Explanation
S1	Issuance of Green bonds	Corporations and governments can issue green bonds to fund sustainable initiatives such as energy efficiency, water waste management, as well as renewable energy projects. Green bonds help investors generate fixed income returns and support sustainable goals.
S2	Improve transparency and disclosure	Transparency and disclosure practices are considered very important for green growth promotion in Morocco. We advise Moroccan companies to implement policies and procedures that help enhance the disclosure of ESG and sustainability performance.
S3	Encourage social responsibility and community engagement	To support green growth and social well-being in Morocco. The country needs an effective community engagement and dedication to social responsibility, we advise companies in Morocco to engage with local communities to meet their wants and address their concerns.

S4	Partnership with international partners	To better promote green growth, we advise businesses in Morocco to do partnerships with international partners to create synergy by sharing resources, practices and skills. We advise stakeholders to promote international partnership that aim to address sustainable issues.
S5	Shareholder Engagement	We advise companies to actively engage in promoting and encouraging sustainable practices and this is through addressing ESG issues, filing shareholder proposals that aim on tackling sustainable concerns and voting participation on shareholder resolution during annual general meetings.
S6	Government Support for FinTech	This policy is about the level of assistance and encouragement, the Moroccan government should be providing both financial and non-financial support to encourage and promote the adoption of financial technology solutions that help in improving financial processes and operational efficiency.
S7	Technological Infrastructure Readiness	We advise that the Moroccan government should invest heavily in technological infrastructure to help improve the quality and speed of internet in both rural and urban areas to help everyone access to digital platforms, we also point on the availability data centers in Morocco.
S8	Green finance innovation and development support	The Moroccan government should invest more in the development of cutting-edge technologies and innovations that help in sustainable development by promoting the implementation of financial technology that help in developing green financial products and services.
S9	Development and enforcement of environmental regulations	We advise the country to act on the Development and enforcement of environmental regulations through pushing firms to be environmentally responsible by implementing and respecting sustainable practices.

Instructions: You need to consider the relative importance of strategic solution based on each sub-indicator. Below is an example of filling out this Matrix Style Table.

Example: Please rate the importance of strategic solution (S1) based on each Sub-Indicators (ENV1-TCHI5). In this case you are required to consider your judgment and put down importance/score (1–5).

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO C1	SO C2	SO C3	SO C4	SO C5	SO C6	SO C7	GO V1	GO V2	GO V3	GO V4	GO V5	GO V6	GO V7	FIN V1	FIN V2	FIN V3	FIN V4	FIN V5	FIN V6	TC HI 1	TC HI 2	TC HI 3	TC HI 4	TC HI 5
S1																																

Please rate the importance of **strategic solution (S1)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO C1	SO C2	SO C3	SO C4	SO C5	SO C6	SO C7	GO V1	GO V2	GO V3	GO V4	GO V5	GO V6	GO V7	FIN V1	FIN V2	FIN V3	FIN V4	FIN V5	FIN V6	TC HI 1	TC HI 2	TC HI 3	TC HI 4	TC HI 5
S1																																

Please rate the importance of **strategic solution (S2)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO1	SO2	SO3	SO4	SO5	SO6	SO7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN1	FIN2	FIN3	FIN4	FIN5	FIN6	TCHI1	TCHI2	TCHI3	TCHI4	TCHI5
S2																																

Please rate the importance of **strategic solution (S3)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO1	SO2	SO3	SO4	SO5	SO6	SO7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN1	FIN2	FIN3	FIN4	FIN5	FIN6	TCHI1	TCHI2	TCHI3	TCHI4	TCHI5
S3																																

Please rate the importance of **strategic solution (S4)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO1	SO2	SO3	SO4	SO5	SO6	SO7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN1	FIN2	FIN3	FIN4	FIN5	FIN6	TCHI1	TCHI2	TCHI3	TCHI4	TCHI5
S4																																

Please rate the importance of **strategic solution (S5)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV1	ENV2	ENV3	ENV4	ENV5	ENV6	ENV7	SO1	SO2	SO3	SO4	SO5	SO6	SO7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN1	FIN2	FIN3	FIN4	FIN5	FIN6	TCHI1	TCHI2	TCHI3	TCHI4	TCHI5
S5																																

Please rate the importance of **strategic solution (S6)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV 1	ENV 2	ENV 3	ENV 4	ENV 5	ENV 6	ENV 7	SOC 1	SOC 2	SOC 3	SOC 4	SOC 5	SOC 6	SOC 7	GO V1	GO V2	GO V3	GO V4	GO V5	GO V6	GO V7	FIN V 1	FIN V 2	FIN V 3	FIN V 4	FIN V 5	FIN V 6	TCHI 1	TCHI 2	TCHI 3	TCHI 4	TCHI 5
S6																																

Please rate the importance of **strategic solution (S7)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV 1	ENV 2	ENV 3	ENV 4	ENV 5	ENV 6	ENV 7	SO C 1	SO C 2	SO C 3	SO C 4	SO C 5	SO C 6	SO C 7	GO V1	GO V2	GO V3	GO V4	GO V5	GO V6	GO V7	FIN V 1	FIN V 2	FIN V 3	FIN V 4	FIN V 5	FIN V 6	TC HI 1	TC HI 2	TC HI 3	TC HI 4	TC HI 5
S7																																

Please rate the importance of **strategic solution (S8)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV 1	ENV 2	ENV 3	ENV 4	ENV 5	ENV 6	ENV 7	SOC 1	SOC 2	SOC 3	SOC 4	SOC 5	SOC 6	SOC 7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN 1	FIN 2	FIN 3	FIN 4	FIN 5	FIN 6	TCHI 1	TCHI 2	TCHI 3	TCHI 4	TCHI 5
S9																																

Please rate the importance of **strategic solution (S9)** based on each Sub-Indicator (ENV1-TCHI5). You are required to consider your judgment and put down **importance/score (1–5)** in this Matrix Style Table.

	ENV 1	ENV 2	ENV 3	ENV 4	ENV 5	ENV 6	ENV 7	SOC 1	SOC 2	SOC 3	SOC 4	SOC 5	SOC 6	SOC 7	GOV1	GOV2	GOV3	GOV4	GOV5	GOV6	GOV7	FIN 1	FIN 2	FIN 3	FIN 4	FIN 5	FIN 6	TCHI 1	TCHI 2	TCHI 3	TCHI 4	TCHI 5
S8																																