

The Extent of Sustainable Accounting Implementation and Identification of Factors Affecting Sustainable Accounting in the Saudi Business Environment (Case Study: SMEs in the Asir Region)

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Abstract

The main purpose of this study was The Extent of Sustainable Accounting Implementation and Identification of Factors Affecting Sustainable Accounting in The Saudi Business Environment (Case Study: SMEs in the Asir Region). The method of this study was Descriptive – survey. The statistical population of this study was SMEs managers in Asir Region that their number is 100 persons. The sample size was estimated using Cochran formulate as 80 mangers and they were selected by random cluster sampling. The tool to collect data was a researcher-made questionnaire was used. The validity of the questionnaire was confirmed by supervisor and a number of management and accounting professors and the reliability of the questionnaire was confirmed by Cranach Alpha which was 0.92. The collected questionnaires were analyzed by One-sample T-test, Exploratory factor analysis (EFA) and AHP Fuzzy by SPSS and Matlab software. Findings showed the rate of using sustainable accounting in the Saudi business environment is significantly at the desired level and above the expected average level. Also, findings showed that factors affecting sustainable accounting were identified and categorized into five main factors including ownership structure, company size, financial leverage, corporate governance structure, and supervisory structure.

Keywords: Sustainable Accounting; SMEs; Asir.

1. Introduction

Today, companies cannot win only through operational or financial superiority in the field of competition and bring customers along with them. In today's world, something more than these is needed to give the company a competitive advantage. The present era is a time when customers and society expect companies and organizations to be responsible and consider future generations in their activities and operations (Bebbington & Unerman, 2018). It is necessary for the strategic functions of companies in such an environment, along with knowing the market and customers as well as possible in order to achieve a greater share of the competitive market, paying attention to sustainability in various areas such as society; environment and economy (Orefice and Nyarko, 2020). Because many changes in the last century and the current century for the development of the industrialization of societies have been accompanied by the destruction of the environment. and the loss of biological species; increasing carbon dioxide by half; destruction of the ozone layer; Annual reduction of about 13 hectares of forests in the last ten years; production of high volume of wastes; The annual death of 5 million people exposed to chemical waste is only part of its negative consequences. The continuation of this trend can cause severe destruction of resources and imbalance in the basic areas of sustainable development, namely economic dimensions; social and environmental (Amjad et al., 2021).

Organizations giving importance to future generations in performing their activities as well as consuming resources is a positive step towards achieving sustainable development. Moreover, it indicates the transparent responsiveness of the organization to the stakeholders, which requires the development of organizational boundaries and reporting in line with appropriate accountability and transparency of information for a wide range of stakeholders (Bebbington & Unerman, 2018). If the company ignores the need for sustainability, then there are potential risks of unbearable burdens on sustainability. Therefore, the lack of ethics and transparency in accounting is considered as an important issue as it saw in WorldCom and the collapse of Enron and the Asian economic crisis in 1977 and in US subsidiaries in 2007 all stemmed from the lack of sustainability accounting (Marzaki et al., 2017).

Sustainability accounting, Ethics and respecting the rights of stakeholders in creating a link between economic effects, Social and environmental subjects play an important role based on concepts arising from social responsibility. Unlike traditional accounting that only includes financial aspects in information disclosure, it emphasizes on maintaining the long-term interests of stakeholders inside and outside the organization (Lodhia, Sharma and Low, 2021). The area of sustainability accounting is expanding with the goal of capturing the social and environmental effects of an organization's operations and incorporating them into decision-making procedures (Ehnert et al., 2016). The

sustainability accounting concept involves the treatment of business transactions that is performed by companies (considering economic, environmental, and social factors). The disclosure of the results through sustainability reports (Cantele, Tsalis and Nikolaou, 2018), the provision of adequate information on sustainability corporate performance to society (Gimenez, Sierra and Rodon, 2012), and the process of communicating an organization's effects on internal and external users through financial and non-financial reporting. A framework for understanding an organization's influence on these larger stakeholders and taking measures in keeping with their values and objectives is provided by sustainability accounting. As the need for corporations to account for their social and environmental consequences grows, sustainability accounting has emerged as a reaction (Hörisch et al., 2020). This concept recognizes the responsibility of organizations to provide financial information to shareholders about the impact of its non-financial activity (e.g., information concerning energy efficiency, waste management, wastewater, chemicals and waste metals, employment, occupational health and safety, human talent training, community and volunteerism, supply chain, quality control, regulation and compliance) in the triple bottom line framework [36]. Organizations are assisted by sustainability accounting in identifying possibilities to enhance their social and environmental performance as well as in managing the risks connected to sustainability-related concerns. Furthermore, it gives stakeholders the knowledge they require to assess an organization's sustainability performance and make educated decisions (Schaltegger et al., 2022).

Sustainability has become a significant priority for organizations due to its long-term impact on the organization's success and its adaptation to the requirements of the business environment (Sayyadi Tooranloo and Askari Shahamabad, 2020). The company must align its activities with society's expectations to be sustainable. The expectations have no longer been limited to profits and providing goods and services for decades (Arianpoor and Salehi, 2021).

The adoption of sustainable accounting can be theoretically grounded in stakeholder theory, which posits that organizations must account for the interests of a broad range of stakeholders—beyond shareholders—by integrating economic, social, and environmental performance into their reporting (Freeman, 1984; Gray, 2010). Additionally, agency theory highlights the role of governance structures, such as audit committees and ownership patterns, in aligning managerial actions with sustainability goals, thereby reducing information asymmetry (Jensen & Meckling, 1976). This study leverages these theoretical lenses to explore how factors like ownership structure and corporate governance influence sustainable accounting in Saudi SMEs. Despite the growing global emphasis on sustainability accounting, a significant research gap exists, particularly in emerging markets like Saudi Arabia, where limited studies have addressed its implementation within the SME context (Schaltegger & Burritt, 2010). Globally, sustainable accounting has gained traction as a critical tool for addressing environmental and social challenges, with organizations in developed economies adopting frameworks such as those outlined by the OECD (2017) to integrate sustainability into financial reporting. Studies in Europe and North America, such as those by Schaltegger and Burritt (2010), emphasize the role of governance and innovation in driving sustainable practices. However, the application of these global trends to emerging markets, particularly SMEs in regions like Saudi Arabia, remains underexplored, highlighting the need for context-specific research to bridge this gap and adapt international best practices to local conditions.

In recent years, the Kingdom of Saudi Arabia has embarked on an ambitious journey of transformation, aiming to diversify its economy beyond oil dependency. At the heart of this transformation is the Vision 2030 plan, which seeks to foster a vibrant society, a thriving economy, and an ambitious nation. Small and medium-sized enterprises (SMEs) are pivotal in this endeavor, as they constitute the backbone of the economy, contributing significantly to employment and GDP (Tarifi, 2024). SMEs a significant part of the economy of developed and developing countries. In addition, they are known as an essential axis for economic growth, employment, poverty reduction and industrial development (Estensoro et al., 2022). SMEs have had an economic impact in many countries and have been considered essential in sustainable development. One of their characteristics is the inability to internalize all elements of innovation, which is caused by the lack of resources such as capital, knowledge and time (Jones and Zubielqui, 2016). Serious environmental problems caused by rapid economic development have caused academics and industrialists to pay more attention to the sustainable performance of companies (Jiang et al., 2018). Also, increasing concern about excessive consumption of resources, environmental destruction and social inequalities has raised the need to achieve a sustainable economy and society (Jones and Zubielqui, 2016). One of the issues in this field, as mentioned, is sustainable development accounting. Therefore, because no research has been done in this regard in Saudi Arabia, the necessity of the present research was formed. Therefore, the main purpose of this research is the extent of using sustainable development accounting and identifying the factors affecting sustainable development accounting.

1.1. Sustainable Accounting

Corporate sustainability has been an essential issue from the beginning of the 21st century as a positive challenge in economics and commerce to be widely used in the public and social sectors. Increasing attention and demand for transparency and accountability in sustainable development leads managers to ensure that sustainable development balances the positive economy and community pressure against the negative environment and community. Sustainability accounting should express the organization's economic, social, and environmental effects according to the triple concept. However, traditional accounting focuses only on the financial and economic consequences of commercial activities to maximize shareholder profits. Sustainability accounting has recently emphasized integrating ethics into the community, environment, and economy (Putang, 2011). Ethical and economic behavior can lead to achieving the goal of large companies because ethical behavior can bring economic rewards to companies (Namazi and Rajab Dori, 2017). Sustainable accounting extends beyond traditional financial reporting by incorporating non-financial dimensions, aligning with stakeholder theory's emphasis on transparency and accountability to diverse stakeholders (Gray, 2010). It also addresses agency issues by enhancing governance mechanisms, such as the supervisory structure, to ensure ethical practices and long-term value creation (Schaltegger & Burritt, 2010). However, the application of these principles in SMEs, especially in regions like the Asir region of Saudi Arabia, remains underexplored, necessitating this study to fill this research gap and provide context-specific insights.

Sustainability accounting emphasizes the concepts of social responsibility, accounting ethics and stakeholders, which includes components (awareness of accounting ethics, voluntary accounting activity, transparency of accounting mindset, disclosure of human capital and social responsibility reporting).

- A) Awareness of accounting ethics: Ethical awareness is an essential element of the practice of the accounting profession, so that every accountant must have ethical ability, because this category is an important aspect for the quality of reported financial information. For this reason, professional accounting institutions, in order to improve professional ethics, teach their members the awareness of accounting ethics or decide to teach them (Sernika, 2007). In ethical behavior, increasing the confidence of shareholders in the company should be considered as one of the moral demands and an important goal (Baloghani, 2020).
- B) Voluntary accounting activity: Voluntary accounting activity mainly includes compliance with related policies, methods and laws in order to maintain the company at the highest level of social acceptance and reputation in the market. Today, different companies choose

different ways to voluntary show themselves in improving environmental management even beyond legal requirements, which sometimes leads to improved financial performance and dynamic production of companies (Aragon et al., 2007).

- C) **Clarity of accounting mindset:** Clarity of accounting mindset refers to reliable information that enables users to make accurate decisions. In other words, the transparency of the accounting mindset includes reliable information that leads users to make accurate and correct decisions. That is, the transparency of the accounting mindset is a point of view about the full disclosure of processes, processes, assumptions in the preparation of the report. In other words, the transparency of the accounting mindset is to make the accounting activities transparent. Companies use accounting transparency for reliable information about their relative performance, financial position, investment opportunities, value and risk. Companies need transparency to avoid stagnation and because of society's expectations (Bushman et al., 2007).
- D) **Disclosure of human capital:** Human capital refers to education, knowledge, skills, learning, expertise and experience. The disclosure of human capital is defined as the disclosure of organizational information about employees' education, knowledge, learning skills, expertise and experiences in their tax report (Hopod et al., 2010). Huang et al. (2010) stated that human capital disclosure is varied in terms of reporting form and content and is mostly voluntary and often the perspective of adequate disclosure of human capital information is important. Because it not only affects a company's ability to hire and retain the best people, it also creates potential value for a company. Human capital information is an important component in the company's potential decision making in the future and it is beneficial for companies that seek to satisfy all investors requesting information to increase market value.
- E) **Social responsibility report:** A report that has affects business activity and even negative factors affecting it such as employees, social participation, environmental concern and other ethical issues. For this purpose, social responsibility reporting is becoming more colorful towards strengthening environmental performance and improving the work environment and social welfare, which may be the best advertisement for a company (Branco and Rodriguez, 2008).

1.2. Factors Affecting Sustainable Accounting and Its Results

The results of various researches show that sustainability accounting is essential for companies and commercial organizations. Based on the results obtained, sustainable accounting methods may help companies achieve better sustainability results by providing a framework for measuring, reporting and monitoring sustainability performance. Adams et al. (2016) discovered that firms might identify and handle sustainability risks, including climate change and resource depletion, with the use of sustainability accounting. Sustainability accounting, according to (Schaltegger et al., 2018) may aid firms in increasing resource efficiency, cutting waste, and increasing sustainability-related innovation. Moreover (Albareda & Hajikhani, 2019), discovered that sustainable accounting may aid firms in improving their decision-making and performance results by assisting them in aligning their sustainability goals with their overall strategy. Ullah & Sun (2021) investigated the connection between company innovation and sustainability accounting. Putang (2011) investigated the causal relationships of sustainability accounting dimensions with the financial health of companies and reached the conclusion that sustainability accounting elements (accounting ethics, voluntary activities, transparency, human capital disclosure and social responsibility) have a direct and meaningful relationship with the survival of listed companies in Thailand Stock Market. Salim Salem (2016) showed that there is a positive and significant relationship between accounting information and accounting sustainability. In addition, their results indicated that the quality of accounting information with a focus on the variable of sustainability has a positive and significant relationship with the performance of companies. Fang et al. (2016) showed that accounting sustainability in conservative companies is different from accounting sustainability in non-conservative companies. In addition, with increasing conservatism, accounting stability increases. Moreover, no obvious difference was observed between accounting stability in companies with conditional conservative accounting and companies with unconditional conservatism. Chen et al., (2015) states that one of the ways to express the activities and effects of the organization is presenting a sustainability report and a corporate social responsibility report. Today, globally prominent companies present such reports every year in which they express their activities and effects on the society in line with the organization's social responsibility.

2. Methodology

The method of this study was Descriptive – survey. The statistical population of this study was limited to 100 SME managers in the Asir region due to resource constraints and the feasibility of data collection within the study period. The sample size was estimated using Cochran formulate as 80 mangers and they were selected by random cluster sampling and ensuring statistical reliability for the targeted population, though future studies with a broader geographical scope are recommended to enhance the applicability of the results. This regional focus was chosen to provide a detailed case study, but it restricts the generalizability of the findings to other regions of Saudi Arabia or globally. The tool to collect data was a researcher-made questionnaire was used. The validity of the questionnaire was confirmed by supervisor and a number of management and accounting professors and the reliability of the questionnaire was confirmed by Cranach Alpha which was 0.92. The collected questionnaires were analyzed by One-sample T-test, Exploratory factor analysis (EFA) and AHP Fuzzy by SPSS and Matlab software.

3. Findings

3.1. Descriptive Findings

Demographic variables result showed that %73.4 of the samples were men and 26.6% were women. Also, 71% of the sample have a bachelor's degree, 23.5% of the sample has a master's degree and 5.5% of the sample have a doctoral degree. Also 4.5 of the sample under 5 years, 31.5% of the sample 5-10 years, 54% of the sample 10-15 years, 10% of the sample over 20 years' experience.

3.2. Inferential Statistics

Exploratory factor analysis (EFA) is used in order to identify the components or underlying factors of the questionnaire to identify factors affecting the development of sustainable accounting in the Saudi business environment. As can be seen in table (1), the value of KMO is equal to 0.822, which is more than the value of 0.6for the items of the questionnaire to identify the factors affecting the development of

sustainable accounting in the Saudi business environment; also, the significance level of Bartlett's test is smaller than the 5% error level ($\text{sig} < 0.05$). Therefore, the correlation matrix of the data is possible to enter the factor analysis according to the adequacy of sampling and the significance of Bartlett's test.

Table 1: Sampling Adequacy Test to Perform Factor Analysis for the Questionnaire to Identify Factors Affecting the Development of Sustainable Accounting in the Saudi Business Environment

Index	Index estimation
KMO Index	0.822
Bartlett's sphericity index	839.276
FD	154
Sig	0.002

Considering the factor loadings greater than 0.5 as the basis of the meaningfulness of the items to enter the factors, an exploratory factor analysis was performed using the principal component analysis (PCA) method for the questionnaire items. As can be seen in table (2), five factors with eigenvalues above one factor have been extracted, and the eigenvalues of the first, second, third, fourth, and fifth factors are 4.22, 3.36, and 2.72, respectively., 2.11 and 1.89 and the explained variance is 34.145, 20.341, 16.129, 8.101 and 3.673 percent, respectively. The five extracted factors have explained 82.389 percent of the variance of sustainable accounting development in the Saudi business environment.

Table 2: Factors Extracted from the Identification Questionnaire to Identify the Factors Affecting the Development of Sustainable Accounting in the Saudi Business Environment

Factors	Eigen Value	Percentage of Explained Variance	Cumulative Percentage of Explained Variance
First Factor	4.22	34.145	34.145
Second Factor	3.36	20.341	54.486
Third Factor	2.72	16.129	70.615
Fourth Factor	2.11	8.101	78.716
Fifth Factor	1.89	3.673	82.389

The amount of factor loadings obtained for each of the items of the questionnaire to identify the factors affecting the development of sustainable accounting in the Saudi business environment based on exploratory analysis using the principal component analysis (PCA) method is shown in Table (3). It has not yet been determined which of the items are factors and are placed in the same group or factor.

Table 3: The Obtained Factor Loadings' Matrix of the Questionnaire Items for Identifying Factors' Affecting the Development of Sustainable Accounting in the Saudi Business Environment

Objects	factor load
Foreign ownership has an effect on the development of sustainable accounting in the Saudi business environment.	0.899
The concentration of ownership has an effect on the development of sustainable accounting in the Saudi business environment.	0.829
Family ownership has an impact on the development of sustainable accounting in the Saudi business environment.	0.788
Total assets have an impact on the development of sustainable accounting in the Saudi business environment.	0.737
The amount of sales has an effect on the development of sustainable accounting in the Saudi business environment.	0.746
Foreign sales have an impact on the development of sustainable accounting in the Saudi business environment.	0.739
The ratio of total liabilities to total assets has an effect on the development of sustainable accounting in the Saudi business environment.	0.765
The ownership ratio has an effect on the development of sustainable accounting in the Saudi business environment.	0.786
Political communication has an impact on the development of sustainable accounting in the Saudi business environment.	0.707
The presence of internal audit has an effect on the development of sustainable accounting in the Saudi business environment.	0.695
The independence of audit committee members has an effect on the development of sustainable accounting in the Saudi business environment.	0.689
The financial expertise of the audit committee has an impact on the development of sustainable accounting in the Saudi business environment.	0.723
The labor law has an impact on the development of sustainable accounting in the Saudi business environment.	0.776
The anti-money laundering law has an impact on the development of sustainable accounting in the Saudi business environment.	0.719
Environmental and social laws have an impact on the development of sustainable accounting in the Saudi business environment.	0.598

Based on the five extracted factors, the factor matrix was rotated with the Varimax orthogonal rotation method. After the number of factors has been determined and the items related to each factor with a factor load greater than 0.5 in which it was significant. In order to discriminate group items from each other, or in other words, which items are also factors; as it presented in Table (4).

Table 4: The Items Related to Each Factor and the Amount of Factor Loadings Obtained from the Matrix Found in the Questionnaire to Identify Factors Affecting the Development of Sustainable Accounting in the Saudi Business Environment

Factor	Objects	Load Factor
First Factor	Foreign ownership has an effect on the development of sustainable accounting in the Saudi business environment.	0.824
	The concentration of ownership has an effect on the development of sustainable accounting in the Saudi business environment.	0.764
	Family ownership has an impact on the development of sustainable accounting in the Saudi business environment.	0.865
Second Factor	Total assets have an impact on the development of sustainable accounting in the Saudi business environment.	0.767
	The amount of sales has an effect on the development of sustainable accounting in the Saudi business environment.	0.759
	Foreign sales have an impact on the development of sustainable accounting in the Saudi business environment.	0.746
Third Factor	The ratio of total liabilities to total assets has an effect on the development of sustainable accounting in the Saudi business environment.	0.731
	The ownership ratio has an effect on the development of sustainable accounting in the Saudi business environment.	0.773
Fourth Factor	Political communication has an impact on the development of sustainable accounting in the Saudi business environment.	0.692
	The presence of internal audit has an effect on the development of sustainable accounting in the Saudi business environment.	0.642

Fifth Factor	The independence of audit committee members has an effect on the development of sustainable accounting in the Saudi business environment.	0.611
	The financial expertise of the audit committee has an impact on the development of sustainable accounting in the Saudi business environment.	0.633
	The labor law has an impact on the development of sustainable accounting in the Saudi business environment.	0.711
	The anti-money laundering law has an impact on the development of sustainable accounting in the Saudi business environment.	0.609
	Environmental and social laws have an impact on the development of sustainable accounting in the Saudi business environment.	0.589

After extracting the factors and determining, the items related to each factor, they should be named. The meaning and interpretation of items derived from factor loads. These meanings must be compared to an external criterion. The naming of each factor is done by considering a common concept and meaning for the objects. After identifying the factors that belong to each other empirically, a conceptual conclusion should be reached from the empirical sharing of the variables that are loaded on a certain factor. According to the concept and common meaning of the items, the names of the extracted factors effective on the development of sustainable accounting in the Saudi business environment are listed in Table (5).

Table 5: Naming the Extracted Factors Effective on the Development of Sustainable Accounting in the Saudi Business Environment

Factors	Factors' Name
First Factor	Ownership Structure
Second Factor	Company Size
Third Factor	Financial Leverage
Fourth Factor	Corporate Governance Structure
Fifth Factor	Supervisory Structure

In order to rank the importance of extracted factors effective on the development of sustainable accounting in the Saudi business environment, fuzzy hierarchical analysis method (AHP Fuzzy) and MATLAB software are used. The fuzzy scales used in the fuzzy hierarchical analysis process are shown in Figure (1).

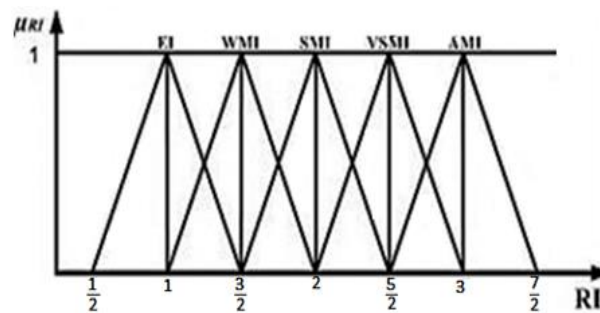


Fig. 1: Linguistic Scales to Express the Degree of Importance.

The concepts and definitions of the fuzzy hierarchical analysis process based on the developmental analysis method are as follows: Two triangular numbers drawn in figure (2) are considered.

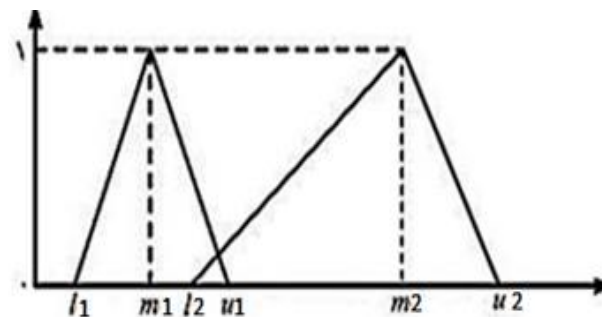


Fig. 2: Triangular Numbers M1 and M2.

Its mathematical operators are defined as relations (1), (2) and (3):

$$M1 + M2 = (l1 + l2, m1 + m2, u1 + u2) \quad (1)$$

$$M1 * M2 = (l1 * l2, m1 * m2, u1 * u2) \quad (2)$$

$$M_1^{-1} = \left(\frac{1}{u_1}, \frac{1}{m_1}, \frac{1}{l_1} \right) \quad M_2^{-1} = \left(\frac{1}{u_2}, \frac{1}{m_2}, \frac{1}{l_2} \right) \quad (3)$$

It should be noted that the product of two triangular fuzzy numbers, or the inverse of a triangular fuzzy number, is no longer a triangular fuzzy number. These relations express only an approximation of the real product of two triangular fuzzy numbers and the inverse of a triangular fuzzy number. In the developmental analysis method, for each row of the matrix of paired comparisons, the value, which is a triangular number, is calculated in the form of equation (4):

$$S_K = \sum_{j=1}^n M_{ij} * \left[\sum_{i=1}^m \sum_{j=1}^n M_{ij} \right]^{-1} \quad (4)$$

It represents the line number and agent of the options and indicators, respectively. In the developmental analysis method, after the calculations, the degree of their magnitude should be obtained relative to each other. In general, if 1M and 2M are two triangular fuzzy numbers, the degree of magnitude of M1 over M2 is defined as equation (5):

$$V(M_1 \geq M_2) = 1, \quad \text{if } m_1 \geq m_2$$

$$V(M_1 \geq M_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)}, \quad O.W \quad (5)$$

The magnitude of a triangular fuzzy number from another triangular fuzzy number is obtained from equation (6):

$$V(M_1 \geq M_2, \dots, M_K) = V(M_1 \geq M_2), \dots, V(M_1 \geq M_K) \quad (6)$$

Therefore, the index weight vector will be in the form of equation (7):

$$W'(x_i) = \min\{V(S_i \geq S_k)\} \quad , K = 1, 2, \dots, n$$

$$K \neq i \quad (7)$$

Which is the vector of abnormal coefficients of fuzzy hierarchical analysis process.
But for group fuzzy hierarchical analysis, it is possible to act based on relation (8). (Chang method)

$$I_{ij} = \min(I_{ijk})$$

$$m_{ij} = \left(\prod_{k=1}^K m_{ijk} \right)^{\frac{1}{K}}$$

$$u_{ij} = \max(u_{ijk}) \quad (8)$$

3.3. Compatibility of judgments

Gogos and Butcher (1998) suggested to check the compatibility, two matrices (the middle number and the range of the fuzzy number) are derived from each fuzzy matrix and then the compatibility of each matrix is calculated based on the hourly method. The steps for calculating the compatibility rate of the fuzzy matrices of pair wise comparisons are as follows:

Step 1: In the first step, divide the fuzzy triangular matrix into two matrices. The first matrix consists of the middle numbers of the triangular judgments $A^m = [a_{ijm}]$, and the second matrix includes the geometric mean of the upper and lower limits of the triangular numbers $A^g = \sqrt{a_{iju} \cdot a_{ijl}}$.

Step 2: The weight vector of each matrix is calculated using the hourly method in the following order.

$$w_i^m = \frac{1}{n} \sum_{j=1}^n \frac{a_{ijm}}{\sum_{i=1}^n a_{ijm}} \text{ in which } W^m = [W_i^m] \text{ connection of [1]:}$$

$$w_i^g = \frac{1}{n} \sum_{j=1}^n \frac{\sqrt{a_{iju} \cdot a_{ijl}}}{\sum_{i=1}^n \sqrt{a_{iju} \cdot a_{ijl}}} \text{ in which } W^g = [W_i^g] \text{ connection of [2]:}$$

Step 3: The largest Eigen value for each matrix is calculated using the following relations.

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^n \sum_{j=1}^n a_{ijm} \left(\frac{w_j^m}{w_i^m} \right)$$

Connection [3] λ_{max}

$$\frac{1}{n} \sum_{i=1}^n \sum_{j=1}^n \sqrt{a_{ij} u_{ij} l_{ij}} \left(\frac{w_j^g}{w_i^g} \right)$$

Connection [4] λ_{max}

Step 4: Calculate the compatibility index using the link below:

Connection [5] $CI^m = \frac{(\lambda_{max}^m O)}{(n-1)}$

Connection [6] $CI^g = \frac{(\lambda_{max}^g O)}{(n-1)}$

Step 5: To calculate the inconsistency rate (CR), the CI index is divided by the value of the random index (RI). If the resulting value is less than 0.1, the matrix is considered compatible and usable. Since the numerical values of fuzzy comparisons are not always integers, and even in this case, the geometric mean generally turns them into incorrect numbers, Gogos and Butcher, by producing 400 random matrices, re-created and produced the table of random indices (RI) for fuzzy pairwise comparison matrices.

Table 6: Random Indexes (RI)

Matrix size	RI^m	RI^g
1	0	0
2	0	0
3	0.4890	0.1796
4	0.7937	0.2627
5	1.0720	0.3597
6	1.1996	0.3818
7	1.2874	0.4090
8	1.3410	0.4164
9	1.3793	0.4348
10	1.4095	0.4455
11	1.4181	0.4536
12	1.4462	0.4776
13	1.4555	0.4691
14	1.4913	0.4804
15	1.4986	0.4880

By calculating the inconsistency rate on two matrices based on the following relations, we compare them with a threshold of 0.1:

Connection [7] $CR^g = \frac{CI^g}{RI^g}$

Connection [8] $CR^m = \frac{CI^m}{RI^m}$

If both of these indices were less than 0.1, the fuzzy matrix is consistent. If both were more than 0.1, the decision maker is requested to revise the presented priorities. In addition, if it was only more than 0.1, the decision-maker revises the fuzzy judgments in the intermediate values (ranges).

At this stage, based on the opinions of experts, the matrix of pair wise comparison of indicators has been formed and triangular fuzzy numbers have been used in table (7).

Table 7: Triangular Fuzzy Numbers

spectrum	1	2	3	4	5	6
Preferences	Equal importance	Almost the same importance	A little more important	more important	Much more important	absolutely important
Triangular fuzzy numbers	(1,1,1)	$(\frac{3}{2}, 11, \frac{11}{2})$	$(22, \frac{3}{2}, 11)$	$(\frac{5}{2}, 22, \frac{3}{2})$	$(33, \frac{5}{2}, 22)$	$(\frac{7}{2}, 33, \frac{5}{2})$

Managers and assistants have expressed their preferences by comparing each factor to other factors. The components of the comprehensive pairwise comparison matrix used in the fuzzy hierarchical analysis method. A fuzzy number is a triangle whose first component is the minimum number of polls, the second component is the average number of polls, and the third component is the maximum number of polls.

By writing the formulas of each of the relations 1 to 8 and performing fuzzy calculations in the Matlab environment, we have: Fuzzy geometric mean of theories in pairwise comparisons of systemic corruption prevention factors in government organizations is reported in table (8).

Table 8: Fuzzy Matrix of Paired Comparisons of Organizational Factors Affecting the Development of Sustainable Accounting in the Saudi Business Environment

Factors	ownership structure	Company size	Financial leverage	Corporate governance structure	Supervisory structure
ownership structure	(1, 1, 1)	(0.83, 1.17, 1.51)	(1.11, 1.43, 1.90)	(0.21, 1.23, 1.46)	(0.53, 0.71, 1.21)
Company size	(0.64, 0.82, 1.34)	(1, 1, 1)	(0.45, 1.21, 0.96)	(0.61, 0.83, 1.31)	(0.32, 1.21, 1.35)
Financial leverage	(0.53, 0.70, 0.98)	(0.60, 0.82, 1.18)	(1, 1, 1)	(0.62, 0.70, 1.14)	(0.72, 1.05, 1.11)
Corporate governance structure	(0.69, 0.89, 1.21)	(0.42, 0.33, 1.55)	(0.56, 0.78, 1.31)	(1, 1, 1)	(0.65, 0.89, 0.97)
Supervisory structure	(0.54, 0.59, 1.13)	(0.72, 1.03, 1.48)	(0.96, 1.25, 1.57)	(1.13, 1.41, 1.51)	(1, 1, 1)
Total	(3.40, 4, 5.66)	(3.57, 4.35, 6.72)	(4.08, 5.67, 6.74)	(3.57, 4.97, 6.42)	(3.22, 4.86, 4.64)

By performing a fuzzy matrix of paired comparisons of organizational factors affecting the development of sustainable accounting in the Saudi business environment, the weight of each factor is calculated from the point of view of managers and deputies using Chang's method.

By writing formulas and performing fuzzy calculations in the Matlab environment, we have:

$$S_1 S_1 = (0.122, 0.123, 0.173)$$

$$S_2 S_2 = (0.131, 0.125, 0.359)$$

$$S_3 S_3 = (0.144, 0.246, 0.382)$$

$$S_4 S_4 = (0.112, 0.218, 0.172)$$

$$S_5 S_5 = (0.108, 0.119, 0.152)$$

The magnitude of $S_i S_i$ was determined as follows:

$$V(S_1 S_1 > S_2 S_2) = 0.599 \quad V(S_1 S_1 > S_3 S_3) = 0.825 \quad V(S_1 S_1 > S_4 S_4) = 0.544 \quad V(S_1 S_1 > S_5 S_5) = 1$$

$$V(S_1 S_1 > S_2 S_2, S_3 S_3, S_4 S_4, S_5 S_5) = \min(0.599, 0.825, 0.544, 1) = 0.544$$

$$V(S_1 S_1 > S_2 S_2) = 0.478 \quad V(S_2 S_2 > S_3 S_3) = 0.765 \quad V(S_2 S_2 > S_4 S_4) = 0.683 \quad V(S_2 S_2 > S_5 S_5) = 1$$

$$V(S_2 S_2 > S_1 S_1, S_3 S_3, S_4 S_4, S_5 S_5) = \min(0.478, 0.765, 0.683, 1) = 0.478$$

$$V(S_3 S_3 > S_1 S_1) = 1 \quad V(S_3 S_3 > S_2 S_2) = 1 \quad V(S_3 S_3 > S_4 S_4) = 1 \quad V(S_3 S_3 > S_5 S_5) = 1$$

$$V(S_3 S_3 > S_1 S_1, S_2 S_2, S_4 S_4, S_5 S_5) = \min(1, 1, 1, 1) = 1$$

$$V(S_4 S_4 > S_1 S_1) = 0.431 \quad V(S_4 S_4 > S_2 S_2) = 0.321 \quad V(S_4 S_4 > S_3 S_3) = 0.721 \quad V(S_4 S_4 > S_5 S_5) = 1$$

$$V(S_4 S_4 > S_1 S_1, S_2 S_2, S_3 S_3, S_5 S_5) = \min(0.431, 0.321, 0.721, 1) = 0.321$$

$$V(S_5 S_5 > S_1 S_1) = 0.236 \quad V(S_5 S_5 > S_2 S_2) = 0.376 \quad V(S_5 S_5 > S_3 S_3) = 0.543 \quad V(S_5 S_5 > S_4 S_4) = 0.532$$

$$V(S_5 S_5 > S_1 S_1, S_2 S_2, S_3 S_3, S_4 S_4) = \min(0.236, 0.376, 0.543, 1) = 0.236$$

Therefore, the un-normalized weights of the organizational factors affecting the development of sustainable accounting in the Saudi business environment were obtained as follows:

$$W = (0.554, 0.478, 1, 0.321, 0.236)$$

By dividing the weight of each factor by the total weight of the factors, the standardized weights are as follows:

$$w = (0.213, 0.184, 0.386, 0.123, 0.091)$$

The final weight of the organizational factors affecting the development of sustainable accounting in the Saudi business environment with the AHP Fuzzy method is given in table (10). As can be seen, the financial leverage factor has the highest final weight (0.386), which means that the financial leverage factor is one of the most important organizational factors affecting the development of sustainable accounting in the business environment of Saudi Arabia. The lowest final weight (0.091) is related to the regulatory structure, which means that the regulatory structure factor is one of the least important organizational factors affecting the development of sustainable accounting in the Saudi business environment.

Table 9: The Final Weights of Organizational Factors Affecting the Development of Sustainable Accounting in the Saudi Business Environment with the AHP Fuzzy Method

AHP Fuzzy method			
compatibility index	λ_{max}	Final weight	Factors
0.080	5.36	0.213	ownership structure
		0.184	Company size
		0.386	Financial leverage
		0.123	Corporate governance structure
		0.091	Supervisory structure
The consistency index is less than 0.1, so consistency in judgments is acceptable.			

To assess the extent of sustainable accounting implementation in the Saudi business environment, a one-sample T-test was conducted, comparing the mean scores of sustainable accounting components against an expected average level of 3. The analysis presented in Table 10, includes comprehensive statistical values to substantiate the claim that sustainable accounting is implemented significantly above the expected level ($p < 0.05$). The results of the one-sample T-test, as detailed in Table 10, indicate that the average scores for all sustainable accounting components (ethical awareness, voluntary accounting, clarity of accounting thinking, disclosure of human capital, and social responsibility reporting) are significantly above the expected average level of 3 ($p < 0.05$). This confirms that the rate of using sustainable accounting in the Saudi business environment is at the desired level, aligning with the study's hypothesis.

Table 10: One-Sample T-Test Results to Investigate the Extent of Sustainable Accounting Use in the Saudi Business Environment

Value Test= 3						
V	M	Std. Deviation	DF	The average difference obtained with the test value	t- Value	P- Value
Ethical awareness of accounting	3.98	0.31	80	0.98	3.127	0.019
Voluntary accounting	3.87	0.29	80	0.87	2.983	0.021
Clarity of accounting thinking	4.34	0.20	80	1.34	6.876	0.001

Disclosure of human capital	4.11	0.25	80	1.11	4.322	0.001
Social responsibility report	4.29	0.23	80	1.29	5.461	0.001

4. Discussion

The world is faced with numerous environmental challenges affecting its ecosystem, and transitioning toward a sustainable system has been a herculean task globally. Many countries, including the Kingdom of Saudi Arabia (KSA), have developed various strategies for transitioning to a more sustainable system. The KSA's Vision 2030 revolves around energy transition, economic diversification, and, ultimately, sustainable development (Akinwale, 2024). SMEs still have some strategic qualities that can enable the implementation of sustainability programs. Argued that in SMEs, environmental management is a measurement tool of sustainability and it is attributed to the encouragement driven by relevant associations and other companies in the same field (Soliman et al., 2022). Among the important and fundamental tools for improving the performance and the sustainability of SMEs is sustainability accounting. So, the main purpose of this study was The Extent of Sustainable Accounting Implementation and Identification of Factors Affecting Sustainable Accounting in The Saudi Business Environment (Case Study: SMEs in the Asir Region).

Findings showed that the rate of using sustainable accounting in the Saudi business environment is significantly at the desired level and above the expected average level.

Findings showed that factors affecting sustainable accounting were identified and categorized into five main factors including ownership structure, company size, financial leverage, corporate governance structure, and supervisory structure. And this is consistent with the findings of other researchers, such as Adams et al., (2016), Ullah & Sun (2021), Putang (2011), Salim Salem (2016), Fang et al. (2016), Chen et al., (2015). The findings of this study, particularly the prominence of financial leverage as a key factor (weight=0.386), have potential global implications for SMEs in emerging markets beyond Saudi Arabia. For instance, countries with similar economic diversification goals, such as the UAE or India, could benefit from strengthening financial structures to enhance sustainable accounting adoption, as suggested by OECD (2017) guidelines on SME sustainability. The identified factors—ownership structure, company size, and governance—align with global trends observed in European SMEs (Schaltegger & Burritt, 2010), suggesting that the framework developed here could be adapted internationally, though further cross-country studies are needed to validate this applicability.

A key limitation of this study is its focus on SMEs in the Asir region, which may not fully represent the diverse business environments across Saudi Arabia or other emerging markets. Future research could employ a multi-regional sample within Saudi Arabia or conduct comparative studies with SMEs in other countries, such as the UAE or India, to validate and generalize the findings across broader populations. In the end, it is expected that this research, in addition to enriching the literature of sustainable accounting, can be useful for analysts, managers and policy makers of corporate affairs. To provide more transparent information to the stakeholders by formulating appropriate policies in the field of environmental, social, economic and corporate management issues and disclosing as much of them as possible in financial reports which will ultimately cause the sustainable performance of companies in the long term. Therefore, according to the data analysis results, it is suggested to small and medium companies take measures to calculate the efficiency score of accounting sustainability of companies to consider how to improve sustainable accounting. In addition, in their organizational structure, establish an independent accounting unit or committee for the sustainability of companies in order to formulate strategies and goals.

5. Conclusion

This study underscores the pivotal role of sustainable accounting in advancing the environmental and economic resilience of SMEs in Saudi Arabia. The prominence of financial leverage as a critical factor highlights the need for policies that enhance SMEs' access to sustainable financing, while strong governance and supervision mechanisms emerge as enablers of transparency.

For practitioners, the findings advocate for:

- Structural Reforms: Establishing dedicated sustainability accounting units within SMEs to systematize ESG reporting.
- Policy Interventions: Government incentives, such as tax breaks or grants, to offset the costs of sustainability adoption for smaller firms.
- Stakeholder Collaboration: Partnerships between industry associations, regulators, and academia to develop localized sustainability metrics.

As Saudi Arabia strides toward Vision 2030, integrating sustainable accounting into SME operations will be instrumental in achieving national diversification and sustainability targets. This study not only enriches academic discourse but also provides an actionable roadmap for SMEs, policymakers, and corporate leaders to embed sustainability into organizational DNA. Future research should explore technological solutions (e.g., AI-driven sustainability audits) and cross-border applicability to refine these insights for global relevance.

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