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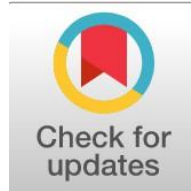
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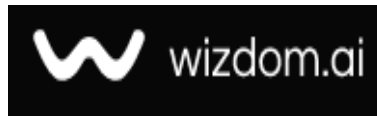
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Green Accounting for Sustainable Development in Oil Distribution: A Babylon Branch Study

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Abstract

General Background Global environmental challenges necessitate modernizing traditional financial frameworks to track ecological footprints. **Specific Background** The Iraqi oil industry heavily relies on standard accounting systems that fail to isolate environmental costs. **Knowledge Gap** Empirical evidence remains limited regarding how multi-level green accounting practices drive overall sustainable development within regional oil distribution centers. **Aims** This study evaluates the implementation of green accounting and its impact on economic, social, and environmental sustainability pillars. **Results** Survey analysis ($N = 206$) demonstrates strong positive correlations ($r = 0.49$ to 0.64 , $p < 0.01$) and significant explanatory power ($R^2 = 0.54$ to 0.64) across organizational levels. **Novelty** The research reveals a crucial knowledge gap among financial staff in isolating environmental expenditures despite high sustainability awareness. **Implications** Energy entities must establish specialized green accounting units and update unified financial manuals to optimize resource efficiency.

Keywords : Green Accounting, Sustainable Development, Environmental Performance, Resource Efficiency, Corporate Accountability

Key Findings Highlights

Multi-level green accounting practices explain up to sixty-four percent of variance in regional sustainable development outcomes.

Tracking hidden environmental expenditures directly minimizes operational waste and improves petroleum distribution safety.

Specialized administrative accounting units are essential to bridge existing knowledge gaps in financial reporting.

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Introduction:

Green accounting has been a significant subject of discussion at both academic and professional levels in recent times, especially with the increasing intensity of global environmental and economic challenges facing countries across the globe. Green accounting indicates a move away from traditional accounting systems towards a more sustainable-based approach to the management of the environment. Green accounting makes use of traditional accounting techniques and tools to measure and evaluate the effects of human economic activity on the environment and to assess the impact that these activities have on the natural resources of the planet and the biodiversity of the planet.

More and more businesses are recognizing the role green accounting plays in their success and sustainability. Green accounting is important because it helps businesses develop economically responsible solutions while also ensuring that there are enough resources for future generations. The relationship between sustainable development and green accounting is critical as it provides businesses with accurate and transparent information about their environmental performance, which in turn allows them to make appropriate economic decisions to meet both their economic goals as well as help protect the environment. Green accounting is not just a measurement tool; rather it is an implementation tool for companies to incorporate environmental considerations throughout their business processes, thus improving their overall environmental performance and decreasing the negative impacts their activities have on the environment. The development of the new economics has created a number of new accounting concepts and practices that relate to how we measure and assess the effects on the environment from economic activity. These include environmental accounting, environmental costing and sustainability reporting; companies are demonstrating their commitment to sustainability through these types of reports.

The study will investigate the concept of environmentally-friendly accounting, its different types and aspects, and will examine its relationship with sustainable development. Additionally it will assess and highlight the connections between green accounting and the implementation of various environmental or developmental policies and how it can assist to achieve sustainable economic, social and environmental objectives..

Section One: Research Methodology

First: Research Problem :

Due to an ongoing rise in environmental issues due to economic and industrial processes (e.g., pollution, depletion of our planet's natural resources and climate change), current accounting concepts must now be modernized to meet the needs of sustainable development. Although interest in 'green accounting', as one way of accounting for the environmental performance and the economic performance of organizations, is increasing; many organizations are still using traditional accounting methods which do not consider environmental costs; therefore they do not reflect accurately how economic activity affects the environment.

One way to use green accounting in a stronger way in order for decision-makers to be able to better support sustainable development is through increased use and dissemination of green accounting information as well as improving the quality of that information. The first major research question will therefore be: How do you leverage the information created from green accounting to support achieving sustainable development?

The answer to this main question must align with the individual's inquiries through:

1. The extent to which the research sample understands the role of green accounting in achieving the sustainable development.
2. What are the influencing external variables and how can be incorporated into the equation of sustainable development?
3. What is the relationship between the green accounting and the sustainable development?

Second: Research Objectives :

1. To clarify and evaluate the role of green accounting in achieving the sustainable development.
2. To determine the level of the application of research dimensions in the sample organization for the sustainable development.
3. To define the role of green accounting in the sustainable development.

Third: Research Significance :

1. The research addresses a compelling and important topic in sustainable development, namely, a concept that opens the door to numerous interpretations and discussions regarding the usefulness and credibility of sustainable development accounting.
2. The study's significance lies in the sector under investigation, namely the private sector, which constitutes a fundamental pillar of economic development in the country, thus enhancing the growth and development of private sector institutions and forming a vital contributor to the national economy.
3. To enrich the Arab libraries in general and the Iraqi libraries in particular, with the aim of increasing intellectual enrichment and knowledge accumulation in the field of the study variables, using the concept of digital auditing to create an e-business environment.

Fourth: Research Hypotheses :

First Main Hypothesis: There is a statistically significant correlation at the (1%) significance level between the green accounting and the sustainable development.

Second Main Hypothesis: There is a statistically significant relationship at the 1% significance level between the green accounting and the sustainable development.

Fifth: Research Limitations :

Spatial Limitations: This research was conducted at the Oil Products Distribution Directorate/Babylon Branch.

Human Limitations: An electronic questionnaire containing a set of questions related to the research variables was distributed to auditors at the Oil Products Distribution Directorate/Babylon Branch.

Temporal Limitations: This refers to the period covered by the research, which extended from November 15, 2015, to January 9, 2026.

Sixth: Research Population and Sample :

1. The research population consists of all employees working at the Oil Products Distribution Directorate/Babylon Branch, across the all job levels (administrative, technical, and financial). This population represents the human element possessing practical experience and knowledge of green accounting implementation mechanisms and the dimensions of sustainable development within the directorate.

2. Research Sample

A comprehensive survey of all employees was not possible therefore, a stratified random sample was selected to obtain representation from all departments (i.e., Accounting, Auditing, Technical Department, and Operations) in reaching a conclusion regarding the employee group.

Sample Size: The final sample size, returned and valid for statistical analysis, consisted of 206 individuals.

Rationale for Size of Sample: Sample sizes of 206 are adequate & statistically representative for descriptive purposes. This provides a sufficient basis for generalizing results to the population of 400-500 (or so) employees, within a reasonable margin of error and with a high level of confidence; Slovin's formulas & Krejcie & Morgan's tables support this..

Seventh: Data Collection Tool

The research relied on a questionnaire as the primary tool for collecting primary data. It was designed based on previous studies and professional standards and was divided into three parts:

Part One: Personal and Professional Data (Age, Educational Attainment, Specialization, and Years of Service).

Part Two: Items measuring the "Levels of Green Accounting Implementation" (comprising 12 items distributed across the national, sectorial, and company levels).

Part Three: Items measuring the "Dimensions of Sustainable Development" (comprising 12 items distributed across the economic, social, and environmental dimensions).

Field Procedures (Methodology Flow):

To ensure the data accuracy, the following steps were followed in distributing the questionnaire:

Face Validity: The questionnaire was presented to a group of expert reviewers at the University of Babylon or equivalent colleges to verify the wording of the items.

Reliability: Cronbach's Alpha test was administered to ensure that the questions yielded consistent results.

Distribution: The questionnaire was distributed manually or electronically to employees at the Directorate headquarters in the city center of Hilla and its affiliated centers.

Section Two: Theoretical Framework of the Research

First Requirement: The Nature of Green Accounting :

First: The Concept of Green Accounting :

Green accounting was defined by the US Department of the Environment as the identification, determination, collection,

analysis, and disclosure of environmental cost information (Abdul Hussein, 2014: 293).

It was also defined as recording the impacts arising from the use of environmental resources, whether positive or negative (Tanc & Etal, 2015: 566).

It was further defined as one of the most important tools used by economic unit management to improve the environmental and economic performance and to address the external challenges and pressures from the government agencies, competitors, customers, and public (Sunitha, 2013: 2).

It was also defined as a means of achieving sustainable development by identifying and measuring the costs of environmental materials and activities and using this information to make administrative decisions (Al-Dulaimi, 2015: 14).

Based on the preceding definitions, the researchers define green accounting as a set of service activities that consider the environmental impact of their operations. This is achieved through accounting information systems that analyze and measure the environmental costs and benefits, assisting the management and stakeholders in decision-making and effective environmental control.

Second: Objectives of Green Accounting

Green accounting aims to achieve several important goals, and the most notable of them are:

1. Environmental reporting to external parties: This is done by providing environmental information to stakeholders outside the economic unit, such as tax authorities, environmental protection associations, and shareholders who request information about the economic unit's environmental performance (Haque, 2011: 28).
2. Environmental conservation and internal process improvement: This is achieved through the optimal use of available resources, the disposal of production waste, and the reduction of air pollution by employing green accounting techniques and their role in addressing these problems through the use of alternative energy sources such as solar energy (Ben Amara, 2011: 270).
3. Designing a Comprehensive Information System for the Economic Unit: Green accounting helps in designing an environmental accounting information system that meets the needs of both internal and external stakeholders of the economic unit (Al-Dulaimi, 2015: 19).
4. Developing the Science of Accounting: Accounting is one of the important sciences that interact with environmental and social issues. Therefore, it is necessary to address these issues, which the other sciences, such as administrative and economic sciences, have already begun to tackle (Al-Dossari, 2011: 28).

Third: Characteristics of Green Accounting

Green accounting is characterized by several features, including: (Othman, 2020: 19)

1. Enabling the company management to accurately calculate the production costs which in turn affect the accuracy of product or the pricing of service.
2. Ensuring the accuracy of accounting information for all parties involved in the administrative decision-making, in order to rationalize decisions by helping to compare the available administrative alternatives and assess the compliance with environmental programs.
3. Enabling the company management to compare the financial reports across the previous years and between different companies within the same sector for monitoring and performance evaluation purposes.
4. Encouraging the economic units to change the production processes or redesign and manufacture the products in a way that doesn't cause any harm to the environment.

Fourth: Levels of Green Accounting Application

Green accounting can be applied at three complementary levels, characterized by the following (Yored, 2019:14):

1. Green accounting at the national level: This level focuses on measuring sustainable development, as the increase in environmental problems has led to a need for indicators that measure the health status, growth rates, and economic progress.
2. Green accounting at the sectorial level: This level focuses on the performance of different economic sectors based on the extent to which these sectors consider the environmental considerations and related aspects, especially those sectors that deplete the environmental resources such as the oil industry, which is considered a sector that wastes the natural capital.
3. Green accounting at the directorate level: The concepts at this level differed with regard to establishing an integrated framework for environmental accounting. Some of them classify it within what is known as a corporate environmental responsibility accounting, while the others call it pollution control accounting.

The second requirement: The nature of sustainable development :

First: The concept of sustainable development

Brundtland Commission describes how we can develop in such a way that we do not negatively impact our children's ability

to develop as well. In their words, "Sustainable Development refers to a type of development that meets the requirements of today, while also considering the needs of future generations." It also states the importance of conserving our Natural Resources for future generations so that we continue to have an adequate number of Resources for future generations.

As described in Shelley, 2014: 65, sustainable development has also been defined as an economic/social/environmental development achieving improvements in these areas as well as a balance between the three systems. The definition provided by Loew et al., 2003: 4 indicates that sustainable development consists of identifying, collecting, analyzing and using physical and financial information for internal decision-making. Therefore based on the previous definitions of sustainable development, the authors conclude that sustainable development includes not only reporting and auditing systems, but also includes life-cycle costing, total cost accounting, benefit evaluation and strategic environmental management planning processes used to manage an organization's sustainability strategy..

Second Requirement: Sustainable Development Goals

Sustainable development aims to achieve several important goals, the most notably of them are (Shariqi et al., 2017: 4):

1. Sustainable development helps maintain a balance between the available resources and the essential needs of humanity in the long term.
2. Providing plans to develop natural resources within a timeframe to achieve intergenerational equity.
3. It maintains the integrity of essential environmental processes in ecosystems such as the soil's ability to regain its fertility.
4. It encourages the regional and international cooperation to address the environmental requirements and challenges.

Third: Characteristics of Sustainable Development

The characteristics of sustainable development can be summarized as follows (Rashwan et al., 2018: 70):

1. It is a continuous, time-bound phenomenon, occurring over a period of at least two generations.
2. The areas and dimensions of development are multifaceted, encompassing not only the economic sphere, but also the environmental and social spheres.
3. It has a horizontal dimension, not limited by geographical boundaries; it has local, regional, and global dimensions.
4. It has multiple concepts, allowing for interpretations based on different perspectives according to the assessments of current and future human needs and how to meet them.

Fourth: Dimensions of Sustainable Development (Buchs & Blanchard, 2015: 702)

1. The Economic Dimension: This dimension focuses on the continuity of the economic unit and the optimal use of resources. For resources, their renewal and maintenance, achieve the sustainable economic growth, capital efficiency, satisfying basic needs, and achieving economic justice.
2. The social dimension: This dimension focuses on combating poverty, achieving social justice, improving the social conditions of the poor in society, improving the quality of education, and providing jobs for the unemployed.
3. The environmental dimension: This dimension focuses on reducing the consumption of non-renewable resources, soil erosion, and deforestation, using green technologies and systems, recycling waste, and relying on clean energy sources.

Third requirement: Green accounting and its relationship to sustainable development

The investors rely on the accounting information contained in the financial statements and reports, and consequently make the investment decisions based on this information. Therefore, the green accounting's response to the ideas of sustainable development contributes to preserving the environment by measuring the environmental costs by the accountant and disclosing them in financial reports, then paying them off by the economic entity to compensate for the resulting damages. This will reduce the negative environmental damage, leading to developments in all environmental, economic, and social fields, which is the basis of the concept of sustainable development to achieve continuity and meet various present needs while giving the future generations the opportunity, to participate in this development (Al-Rikabi et al., 2011: 65). Green accounting contributes to supporting economic development policy by encouraging the economic units to develop or adopt methods for preventing and treating pollution to reduce its impact on the environment. It also involves preparing reports on the costs incurred by the economic unit related to the environment, demonstrating its commitment to implementing laws and regulations concerning the preservation of natural resources and the achievement of sustainable development. Finally, green accounting helps understand the objectives of the economic unit and determine whether these objectives are based on using resources or energy at a rate that allows the nature to regenerate them (Shaabani et al., 2014: 70).

Section Three: The Practical Aspect of the Research

Second: Hypothesis Testing

First Main Hypothesis Test: There is a correlation between the green accounting levels and the sustainable development .

This analysis is a hypothesis test and doesn't state that there is no statistically significant correlation between each dimension of green accounting (individually) and the dimensions of sustainable development (collectively), see Table 1.

Table (1): The results of the correlations between green accounting levels (individually) and the dimensions of sustainable development (collectively).

Index	Green accounting levels			Independent variable
	At the directorate level	At the sectorial level	At the national level	Dependent variable
R	*0.64	*0.54	*0.49	Sustainable
P(sig)	0.000	0.000	0.000	development

***Source: Prepared by the researchers (in the light of the results of SPSS V.22 statistical programming) N=206**

The results in Table (1) manifest that the P(Sig) value is (0.000) for each correlation value, indicating the existence of statistically significant correlations between the individual levels of green accounting (national, sectorial, and directorate levels) and the dimensions of sustainable development (collectively) as follows:

(A) A significant correlation exists at the national level between one of the levels of green accounting and the dimensions of sustainable development (collectively) in the studied directorate, as the correlation coefficient between them reached (0.49) with a significance level of 0.000, which is (1%).

(B) A statistically significant correlation exists between the sectorial level and the dimensions of sustainable development (collectively) in the studied directorate, with a correlation coefficient of 0.54 and a significance level of 0.000 (1%).

(C) A statistically significant correlation exists between the directorate level and the dimensions of sustainable development (collectively) in the studied directorate, with a correlation coefficient of 0.64 and a significance level of 0.000 (1%).

Second Main Hypothesis Test: There is a significance relationship between the green accounting levels and the sustainable development

This analysis tests the second main hypothesis, see Table 2.

Table (2): The results of the green accounting levels (individually) and the dimensions of sustainable development (collectively)

Sustainable Development					R ²	Sig	Dependent variable
t			F				Independent variable
Tabular	Calculated	Beta	Tabular	Calculated			
2.55	10.8	0.89	5.892	132.89	0.63	0.00	Levels of Green Accounting
2.55	6.5	0.74	5.892	54.19	0.54	0.00	At the Directorate level
2.55	6.3	0.64	5.892	51.29	0.64	0.00	At the Sectorial level
2.55	6.6	0.77	5.892	97.48	0.59	0.00	At the National level

Source: Prepared by the researchers (in the light of the results of SPSS V.22 statistical programming) N=206

(A) There is a significant effect at the national level of one dimension of green accounting levels in the sustainable development in the studied directorate:

The first sub-hypothesis: There is no significant effect at the national level of one dimension of green accounting levels in the sustainable development in the studied directorate:

The significance level value (0.00) was less than the hypothetical significance level of the study (1%). At the national level, it indicates, according to the R² analysis coefficient, that (54%) of the total differences in sustainable development in the studied directorate are significant. This is supported by the calculated F-value (54.19), which is greater than its critical value (5.892) at a degree of freedom of (1.110) and a significance level of (1%). The remaining percentage (46%) is attributed to the other variables that cannot be controlled or were not included in the study plan. The Beta regression coefficient was (0.74), which is significant according to the calculated t-value (6.5). This value is greater than its critical value (2.55) and has a significance level of (1%), indicating that a change of one unit at the national level will lead to a change in sustainable development in the studied directorate by (0.74). Based on the above, it can be said that the more the leaders of the studied directorate possess the dimension representing the national level, the more they can activate the sustainable development in the directorate.

(B) A significant effect at the sectorial level of one dimension of green accounting levels in the sustainable development in the studied directorate:

The second sub-hypothesis: There is no significant effect at the sectorial level of one dimension of green accounting levels in the sustainable development in the studied directorate:

The significance level value reached (0.00), which is less than the hypothetical significance level of the study (1%). At the sectorial level, and in terms of the determination value (R²), it explained (64%) of the total differences in sustainable development in the studied directorate. Its significance is supported by the calculated F value. (51.29) is greater than its critical value (5.892), with a degree of freedom of (0.110) and a significance level of (1%). This is attributed to the other variables that could not be controlled or were not included in the study plan. The value of the regression coefficient (Beta) was (0.64), which is significant based on the calculated t-value (6.3). This value is greater than its critical value (2.55) at a significance level of (1%), indicating that a change of one unit at the sectorial level will lead to a change in sustainable development in the studied directorate by (0.64). Based on the above, it can be said that the more the leaders of the studied directorate possess the dimension expressing green accounting at the sectorial level, the more they can activate the sustainable development in the directorate.

(C) There is a significant effect of one dimension of green accounting levels in the sustainable development in the studied national directorate:

The third sub-hypothesis: There is no significant effect of one dimension of green accounting levels at the company level in the study of sustainable development in the national context:

The significance level value reached (0.00), which is greater than the statistical significance level of (1%). At the national level, and using the coefficient of determination (R²), it explained (59%) of the total variations in sustainable development in the national context. This is supported by the calculated F-value (97.48), which is greater than its tabulated value (5.892) at a degree of freedom of (0.110) and a significance level of (1%). The remaining percentage (41%) is attributed to the other variables that cannot be controlled or were not included in the study plan. The regression coefficient (Beta) reached (0.77), which is significant with respect to the calculated t-value (6.6), which is greater than its tabulated value of (2.55) at a significance level of (1%). This indicates that a change in the national level of one unit will lead to a change in the sustainable development in the national context by (0.77). Based on the above, it can be said that all the national leaders under study possessed the dimension expressing the highest level at the national level, more than activating the dimensions of sustainable development in the national.

Section Four: Conclusions, Recommendations, and Future Prospects:

First: Conclusions

1. A significant positive correlation was found between the application of green accounting levels (national, sectorial, and company-level) and the achievement of sustainable development dimensions. This indicates that the environmental accounting awareness directly contributes to improving the directorate's performance.
2. It became clear that the adherence to environmental legislation at the national and sectorial levels is the primary driver for the Babylon branch in adopting green accounting practices. However, implementation at the "company" level (internal procedures) still requires deeper institutionalization.
3. Green accounting contributed to improving the directorate's economic dimension by revealing the hidden environmental costs, leading to cost optimization and reduced losses of petroleum products during the distribution operations.
4. The results evinced that the social dimension in the Babylon directorate is closely linked to occupational safety standards. Accounting for the costs of preventing the environmental accidents led to a reduction in the health risks faced by employees and the surrounding community.
5. Analysis of the responses from the sample (206) reveals a slight knowledge gap among some accounting staff in distinguishing between the regular operating costs and the specialized environmental costs, despite a high level of the awareness of the importance of sustainable development.

Second: Recommendations:

1. The Babil Oil Products Distribution Directorate should establish specialized environmental accounting units or divisions administratively linked to the Finance and Technical Department to ensure the accurate monitoring of green costs and benefits.
2. The current unified accounting system should be developed to include sub-accounting manuals that allow for the separation of environmental costs (such as spill response and tank maintenance costs) from the general administrative costs.
3. Specialized training programs should be intensified for Babil branch employees on how to prepare "green financial reports" that integrate the environmental performance with the traditional financial statements to enhance the transparency for regulatory bodies.
4. Investment in the smart and environmentally friendly technologies at the distribution outlets should be promoted, and the economic feasibility of these investments should be highlighted in the directorate's annual reports to support the sustainable economic development.
5. Activate the incentive and reward system for the departments and employees who present initiatives that contribute to reducing the directorate's carbon footprint or who develop methods to reduce the oil waste and preserve the local environment in Babylon.

Third: Future Prospects

1. The possibility of conducting a comparative study between the Babylon Distribution Directorate and the other directorates in the neighboring governorates to assess the varying efficiency of the green accounting implementation in the Iraqi distribution sector.
2. Moving towards building an integrated accounting model that relies on the artificial intelligence technologies to predict the future environmental costs and measure their impact on the market value and reputation.

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