



Identifying and Optimizing Social Responsibility Accounting Components to Mitigate Environmental Impacts: A Grey Wolf Optimization Approach

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Keywords:

Social Responsibility
Accounting, Environment,
Grey Wolf Algorithm, Ilam
City.

Abstract

Social Responsibility Accounting (SRA) represents a vital framework that empowers stakeholders to evaluate how effectively an organization fulfills its social and environmental responsibilities through transparent and evidence-based disclosures. This study seeks to identify and optimize the key components of SRA that most effectively mitigate adverse environmental impacts, employing the Grey Wolf Optimization Algorithm (GWO) within the operational context of Ilam International Cement Company. The research adopts a mixed-methods design to ensure both conceptual depth and empirical accuracy. In the qualitative phase, a systematic literature review was carried out to extract SRA components directly associated with environmental impact reduction. Out of an initial collection of 178 relevant publications, 16 studies were selected based on rigorous screening criteria, resulting in 12 core SRA components. In the quantitative phase, primary data were collected using a structured questionnaire and analyzed through the application of the Grey Wolf Optimizer to determine optimal combinations of these components. The findings reveal that when six critical components—(1) the degree of commitment to social responsibility, (2) involvement in distinctive or exceptional sustainability actions, (3) clarity and transparency of SRA objectives, (4) stakeholder interaction and communication, (5) integration of SRA into strategic planning and budgeting, and (6) the extent of expenditure and investment in social initiatives—each exceed a threshold value of one, the organization achieves maximum effectiveness in reducing environmental harm. This study demonstrates that integrating theoretically grounded SRA dimensions with advanced metaheuristic optimization methods such as the Grey Wolf Algorithm can substantially enhance an organization's ability to meet both environmental and social sustainability objectives. The results provide a robust and operational framework for industrial enterprises aiming to strengthen their sustainability accounting, enhance stakeholder confidence, and align their organizational practices with internationally recognized environmental governance standards.

Received:

05/Feb/2025

Revised:

15/Mar/2025

Accepted:

29/Apr/2025

How to cite this article:

Ahmadi, F. & Parandin, K. (2025) Identifying and Optimizing Social Responsibility Accounting Components to Mitigate Environmental Impacts: A Grey Wolf Optimization Approach. *Green Development Management Studies*, 4(Special Issue), 79-98. <https://doi.org/10.22077/jgdms.2025.8895.1259>





Introduction

The expansion of industries, businesses, and factories—alongside the development of social institutions, governmental transformations, and evolving ethical standards—has gradually imposed new commitments and obligations on business entities that were not previously recognized or legally enforced to such an extent. One significant consequence of this industrial growth has been the emergence of intricate interconnections between the economy, ethics, and politics, highlighting the mutual influence of economic activities, moral values, and social norms. As relationships among corporations, governments, and individuals have grown increasingly complex, businesses today must demonstrate accountability not only to their stakeholders but also to the broader public. Consequently, managerial priorities have shifted beyond profit maximization and production growth to encompass considerations such as fair employee compensation, product quality and pricing, environmental protection, and broader ethical, political, racial, and social concerns (Sharbatoglu, 2020).

Since every business unit operates within society and interacts with other social members, it must remain conscious of its responsibilities—extending beyond shareholders—to include creditors, employees, customers, suppliers, various societal groups, and the surrounding environment (Foroughi, 2018). Historically, the neglect of such broader interests and the environmental repercussions of business activities led to the emergence of Social Responsibility Accounting (SRA) in the theoretical landscape of accounting during the early 1960s. Influential scholars from Europe, Canada, and Australia, including Anderson, Mobley, and Linus, introduced this concept into academic discourse, with Anderson often recognized as the founding figure of this branch of accounting. The driving force behind this movement stemmed from difficulties in measuring and reporting the external impacts of business units—activities and consequences extending beyond immediate financial interests and incorporating social costs, social benefits, and social returns (Abbott et al., 1979).

Although more than four decades have passed since its inception, SRA remains a relatively new and evolving domain. Its practical implementation has been limited, as most research to date has emphasized concept definition rather than addressing application challenges and pragmatic solutions. The current business environment, characterized by both opportunities and threats, demands that accounting adapt to incorporate social responsibility, risk management, and sustainability reporting. Accountants play a pivotal role in advancing these objectives through their involvement in reporting processes, transparency enhancement, ethical compliance, regulatory adherence, stakeholder interaction, and resource management (Godfrey et al., 2007).

Today, Social Responsibility Accounting represents one of the greatest challenges for organizations because of its inherent connection to Corporate Social Responsibility (CSR). The accounting profession bears the responsibility for quantifying, disclosing, and validating information—including that which reveals the adverse social and environmental impacts of business operations. Companies willing to integrate environmental accounting into their financial statements often achieve greater long-term financial sustainability. Through SRA, businesses that address climate change and environmental issues can simultaneously safeguard their investors, shareholders, and communities from harmful consequences (Alvani & Ghasemi, 2019).

This issue becomes even more critical considering that a company's brand and reputation can profoundly affect society. Unlike traditional financial accounting—which measures profitability, costs, and cash flow—social accounting focuses on evaluating how well a company contributes to social welfare and public well-being. It examines corporate activities to assess the balance between benefits and harm to people and the environment, posing a fundamental challenge for modern enterprises. As corporate operations expand and environmental degradation intensifies, the role and necessity of Social Responsibility Accounting have grown substantially (Molina, 2010). In Iran, the implementation of Social Responsibility Accounting entails a set of distinct challenges and opportunities, which are elaborated below.



Opportunities

1. Emphasis on Social Responsibility in Legal Frameworks

In recent years, Iran has introduced several laws and policy mechanisms promoting corporate accountability toward social and environmental sustainability. Notably, the Law for Improving the Business Environment (2011) and complementary environmental policies oblige organizations to minimize pollution and comply with applicable environmental standards. This legal emphasis establishes the foundation for future institutionalization of Social Responsibility Accounting across industries.

2. Rising Stakeholder Awareness and Social Pressure

As societal and stakeholder awareness of social and environmental issues continues to grow, organizations face heightened expectations for transparent reporting and ethical operations (Jamali & Mirshak, 2007). This evolving public consciousness acts as a driving force, compelling firms to integrate SRA into their management and disclosure practices to maintain legitimacy and trust.

3. Technological Advancement and Data Accessibility

The rapid growth of digital infrastructure and reporting technologies now allows firms to systematically collect, store, and analyze data on social responsibility metrics (Unerman & Bennett, 2004). These advancements facilitate efficient monitoring of sustainability performance and enable real-time integration of SRA indicators into decision-making processes.

Challenges

1. Absence of Unified and Explicit Standards

Despite progress in regulatory development, Iran still lacks standardized guidelines and frameworks for conducting and reporting Social Responsibility Accounting. This gap generates conceptual ambiguity and inconsistency among organizations attempting to measure and disclose social and environmental impacts (Hess, 2007).

2. Resource Constraints: Financial and Human Capital

The successful implementation of SRA requires specialized expertise, dedicated personnel, and sustainable funding. However, many Iranian small and medium-sized enterprises (SMEs) face limitations in both financial and human resources, which restrict their ability to design, execute, and maintain robust SRA systems (Spence, 2007).

3. Prevailing Organizational Culture Focused on Profit Maximization

In certain organizations, a traditional managerial mindset persists—prioritizing financial results over ethical and social considerations. This cultural inertia, characterized by a narrow focus on profitability, can impede the adoption of socially responsible accounting practices and reduce motivation for transparent non-financial reporting (Matten & Moon, 2008).

Despite the existing challenges, the implementation of social responsibility accounting in Iran is feasible, particularly if legal support and necessary infrastructure are provided. Organizations can take effective steps toward implementing this approach by training employees, developing internal standards, and utilizing advanced technologies (Adams & McNicholas, 2007). Additionally, increased public awareness and stakeholder pressure can drive organizations toward adopting social responsibilities and transparent reporting (Gray, 2006). Ultimately, this not only helps improve the social and environmental performance of organizations but can also lead to the establishment of trust and social legitimacy for them (Freeman, 1984).

Minimizing adverse environmental impacts is critical for Ilam International Cement Company for the following reasons:



- 1) Minimizing adverse environmental impacts is essential for the Ilam International Cement Company to comply with national and international environmental regulations. By adopting environmentally responsible practices, the company can ensure compliance with laws such as Iran's Environmental Protection Act and international agreements like the Paris Climate Accord. Cement production is one of the most polluting industries, significantly contributing to greenhouse gas emissions, dust, and other pollutants. Failure to comply with environmental standards can result in legal penalties, fines, and operational shutdowns, which can severely affect the company's profitability and reputation.
- 2) The cement industry is often criticized for its environmental footprint, which can damage a company's reputation. For the Ilam International Cement Company, reducing environmental impacts is essential to build and maintain trust with stakeholders, including investors, customers, and the local community. Transparent reporting on environmental performance through social responsibility accounting can enhance the company's image and demonstrate its commitment to sustainability.
- 3) Minimizing environmental impacts is not only a moral obligation but also an economic necessity. The Ilam International Cement Company can achieve significant cost savings by adopting energy-efficient technologies, reducing waste, and optimizing resource use. For example, using alternative fuels and raw materials in cement production can lower energy costs and reduce emissions. Additionally, avoiding environmental fines and penalties can save the company substantial financial resources.
- 4) Cement production releases harmful pollutants such as particulate matter, nitrogen oxides, and sulfur dioxide, which can negatively affect the health of employees and the surrounding community. For the Ilam International Cement Company, minimizing these emissions is critical to safeguarding public health and ensuring a safe working environment. By reducing its environmental footprint, the company can contribute to the well-being of its workforce and the community. Poor environmental practices can lead to respiratory diseases, cardiovascular problems, and other health issues among workers and local residents, which can result in legal liabilities and increased healthcare costs.
- 5) The Ilam International Cement Company operates in a region where natural resources are finite, and environmental degradation can have long-lasting effects. Minimizing adverse environmental impacts is essential for the company's long-term viability and contribution to sustainable development. By adopting sustainable practices, such as reducing carbon emissions and conserving water, the company can ensure the availability of resources for future generations.
- 6) Global trends are shifting towards sustainability, and companies that fail to address environmental concerns risk losing market share. For the Ilam International Cement Company, minimizing environmental impacts is critical to remain competitive in both domestic and international markets. Consumers and investors are increasingly favoring environmentally responsible companies, and many countries are imposing stricter environmental standards on imported goods.
- 7) Ilam Province faces specific environmental challenges, including water scarcity and air pollution, which are exacerbated by industrial activities. The Ilam International Cement Company has a responsibility to address these local issues by minimizing its environmental footprint. For instance, reducing water usage in cement production and implementing dust control measures can help mitigate the company's impact on the region's fragile ecosystem.

In this context, this research is conducted with the following objectives:

- A. Identifying components of Social Responsibility Accounting aimed at reducing adverse environmental impacts in Ilam International Cement Company. This objective seeks to extract and identify key components of social responsibility accounting that can help mitigate negative environmental impacts.
- B. Optimizing components of Social Responsibility Accounting with the goal of reducing adverse environmental impacts in Ilam International Cement Company. This objective aims to utilize advanced algorithms (such as the grey wolf optimizer) to optimize the identified components and achieve maximum efficiency in reducing environmental impacts.



Research Background

Hashempour Abandansari et al. (2025) in their article titled "The Impact of Social Responsibility on Environmental Accounting (Companies Listed on the Tehran Stock Exchange)" stated that a significant relationship between social responsibility and environmental accounting. Despite the importance of environmental costs, traditional accounting systems often neglect these costs. The adoption of environmental accounting practices can bridge the gap between environmental managers and accountants, enhancing both financial and environmental performance. Policymakers, managers, and regulators should consider integrating social responsibility into strategic planning and regulatory frameworks to promote sustainable business practices.

Tjandrakirana et al. (2024) in their article titled "The Impact of Environmental Performance, Green Accounting, And Corporate Social Responsibility (CSR) on Financial Performance" that The type of data used is secondary data in the form of annual reports of health service companies listed on the Indonesia Stock Exchange in 2018-2023. stated that environmental performance affects financial performance, green accounting affects financial performance, while Corporate Social Responsibility (CSR) does not affect financial performance.

Wijaya et al. (2024) in their article titled "Company Share Values: Examining Corporate Social Responsibility in Rural Development" state that companies can simultaneously utilize company share values and corporate social responsibility (CSR) in distinct areas. The share values of companies pertain to the external domain, while CSR relates to the internal domain.

Sun (2024), in an article titled "Analyzing the Impact of Corporate Social Responsibility on Company Competitiveness," discusses how, in today's social conditions, companies face new opportunities and challenges, shifting competition from talent, products, and economic power to corporate social responsibility (CSR). This shift brings new demands for business development.

Lyska (2024) in a study titled "Theoretical Aspects of Forming a Corporate Social Responsibility Accounting System" demonstrates the necessity of implementing CSR accounting and developing the theoretical aspects of this process. The relevance of this study arises from the increasing acceptance of the CSR concept, which includes integrating environmental, social, and ethical factors into business activities, necessitating the management of these processes. A sufficient information base for planning, evaluating, and analyzing required actions can be developed within an accounting system. Therefore, one of the essential aspects of supporting the development of socially responsible activities is the establishment of a CSR accounting system as an informational foundation for management processes. The goal of this article is to systematize the theoretical aspects of developing an accounting system for corporate social responsibility to provide informational support for company management. This article identifies the nature and critical characteristics of the CSR concept and explores ways to enhance business social responsibility.

Kamali Rad and Shakeri (2024) conducted a study titled "Examining the Impact of Social Responsibility and Service Quality on Customer Satisfaction in Export and Import Trading Companies in Bushehr Province." They investigated the impact of social responsibility and service quality on customer satisfaction in export and import trading companies in Bushehr Province in 2024. The statistical population of this research consisted of 700 individuals from export and import trading companies, from which 248 were selected as a sample based on Cochran's formula. The data collection tool was a questionnaire, the validity and reliability of which were assessed. The findings indicate that social responsibility has a positive and significant impact on customer satisfaction, and service quality also has a positive and significant impact on customer satisfaction.

Ahmadi et al. (2024) examined the moderating effect of ownership concentration on the relationship between the level of social responsibility disclosure and company reputation. The researchers concluded that ownership concentration affects the level of social responsibility disclosure of companies on their reputation. In fact, with concentrated ownership, better decision-making can be achieved and executed more swiftly, ultimately confirming the effectiveness of social responsibility disclosure levels.



Omidkhah et al. (2024) conducted a study titled “The Role of Digital Marketing and Corporate Social Responsibility on Urban Economy in Small and Medium Enterprises.” The analysis of data collected from managers of small and medium enterprises revealed significant positive effects of digital marketing and organizational social responsibility on urban economy.

Azad (2024) wrote an article titled “Examining the Mediating Role of Servant Leadership on the Relationship Between Organizational Citizenship Behavior and Social Responsibility of Employees in Tabriz Municipality.” The results from a sample of 371 showed a positive and significant relationship between organizational citizenship behavior and servant leadership. However, there was no significant relationship between organizational citizenship behavior and social responsibility. There was a positive and significant relationship between servant leadership and social responsibility. Ultimately, servant leadership played a positive and significant mediating role in the relationship between organizational citizenship behavior and social responsibility.

Materials and Methods

Given that both qualitative and quantitative data are utilized simultaneously to analyze and achieve the objectives of this research, the present study is a mixed-methods research. The research is conducted in such a way that the qualitative section employs theoretical analysis and relevant literature on social responsibility accounting to identify its components. Subsequently, in the quantitative section, the Grey Wolf Algorithm is used to optimize these components. The reason for using the Grey Wolf Optimizer (GWO) in this research is related to the unique features and advantages of this algorithm. The Grey Wolf Optimizer is a swarm intelligence-based optimization method inspired by the social behavior and hunting strategies of grey wolves in nature. The use of the Grey Wolf Optimizer in this study is justified due to its high accuracy, fast convergence, simplicity in implementation, and ability to solve multi-objective problems. This algorithm can effectively optimize the components of social responsibility accounting and help organizations reduce their negative environmental impacts. Additionally, the flexibility and efficiency of this algorithm in dealing with real-world data make it a powerful tool for managerial and social research.

Statistical Population and Sample

The qualitative statistical population of this research consists of articles, research proposals, and reputable books published over the past five years. The sampling method in this research is purposive (judgmental). In the quantitative section, the statistical population includes senior managers, deputies, middle managers, and experts from Ilam International Cement Company. The sampling method in this section is also purposive (judgmental), specifically selecting managers and experts who have sufficient familiarity with social responsibility accounting.

Research Findings

Qualitative Data Analysis

Extraction of Social Responsibility Accounting Components Using Systematic Review Method

This section is conducted to extract factors related to social responsibility accounting components aimed at minimizing adverse environmental impacts. The components of social responsibility accounting are extracted in this section.

Step 1: Setting Research Keywords

The texts and articles reviewed in this section include all studies related to social responsibility accounting. To this end, the identification of articles is performed using selected keywords. In this part of the research, the documents studied encompass all research conducted in the field of organizational commitment of human resources within organizations. The researcher conducted a systematic search for published articles in reputable foreign and domestic journals to identify valid, credible, and relevant documents within an appropriate time frame.

**Table 1.** Keywords for Systematic Article Search

Row	(Persian) (English)	Keyword
1	Persian	Social Responsibility Accounting
2	Persian	Harmful Effects on Environment
3	Persian	Social Responsibility Accounting and Harmful Effects in Environment
4	(English)	Social Responsibility Accounting
5	(English)	Harmful Effects on Environment
6	(English)	Social Responsibility Accounting and Harmful Effects in Environment

Step 2: Searching for Relevant Research Studies

The selected articles were chosen for their close relevance to the research domain. Given that the aim of the study is to extract components of social responsibility accounting to minimize adverse environmental impacts, several articles in this area that have a close semantic relationship with the research topic were also selected. As observed, these keywords were utilized in databases to retrieve articles. To address the issue of overlap across different sites, the titles of the articles were audited to prevent redundancy.

Table 2. Articles Reviewed in Databases

Database Name	Number of Articles Reviewed
Science Direct	25
Springer	17
Emerald	24
Scopus	15
Google Scholar	27
Web of Science	22
SID	19
Noormags	16
Magiran	13
Total	178

At this stage, it is necessary to specify the studies reviewed in the systematic review and those that were excluded. Based on the criteria set forth in Table 3, the articles will be further narrowed down for better control.

Table 3. Article Review Criteria

Row	Exclusion Criteria	Inclusion Criteria	Parameters
1	Articles not published in English or Persian	Studies published in English or Persian	Language
2	Articles published before 2019 and before 1398	Articles published from 2019 to 2024 and Persian articles from 1398 to 1403	Time
3	Articles with topics and research areas different from research objectives	Articles that have a close semantic relationship with the research domain and include the searched keywords	Research Topic
4	Non-reputable journals, personal opinions	Articles published in reputable scientific journals and conferences	Type of Studies
5	Articles lacking clear and transparent research processes and results	Articles with clear and transparent research processes and results	Status of Article

Step 3: Selection of Qualified Research Studies

In this step, the articles that meet the established criteria will be selected for further analysis. The systematic review process will ensure that only the most relevant and credible studies are included, thereby enhancing the quality and reliability of the research findings related to social responsibility accounting and its impact on minimizing adverse environmental effects.



The selected articles will then be analyzed to extract the necessary components of social responsibility accounting, as outlined in the research objectives. This rigorous selection process is crucial for ensuring that the findings are based on solid evidence and contribute meaningfully to the field of study.

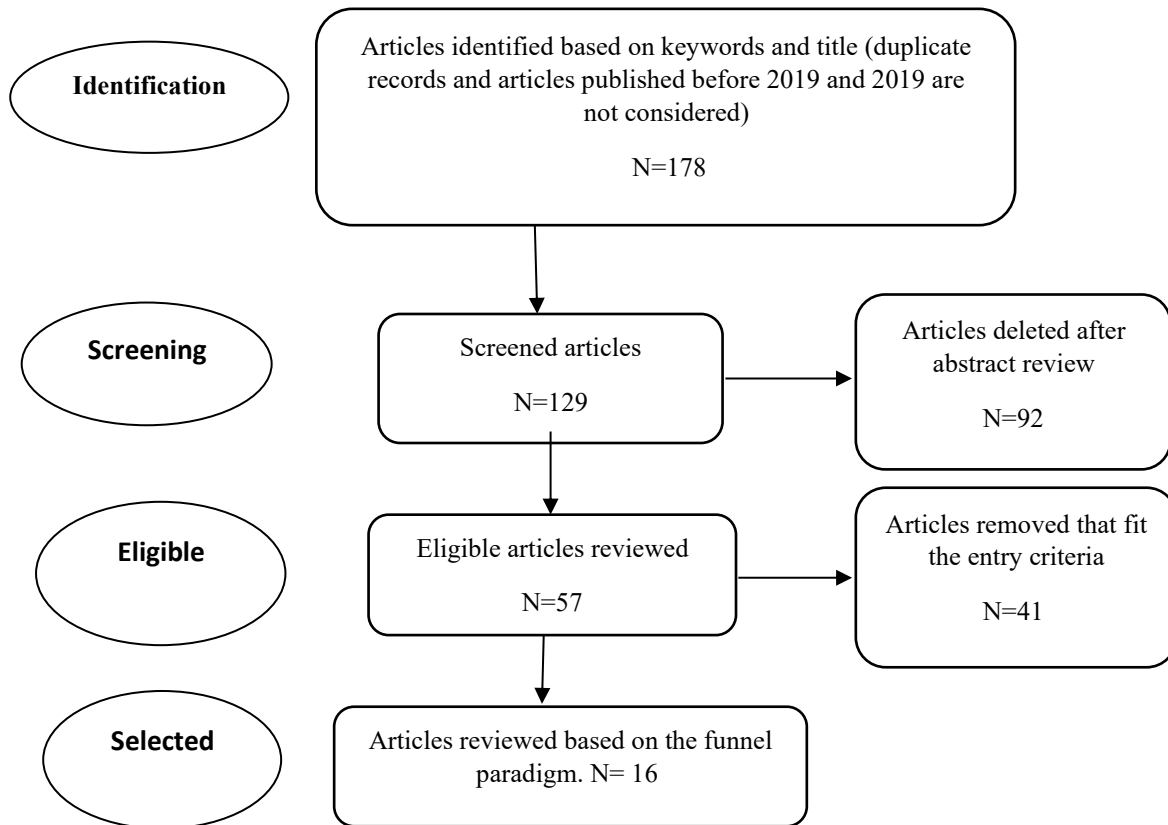


Figure 1. Flowchart of the article review process

The review process of step three was conducted using the CASP program. The CASP (Critical Appraisal Skills Programme) assessment tool is designed for evaluating the quality of primary studies in qualitative research methods. This tool is one of the methods for measuring the validity and reliability of the qualitative section of research. At this stage, all searched articles were examined based on their title, abstract, structure, content, and other sections. In qualitative studies, the CASP assessment tool, which includes ten rubric criteria, is typically employed. These criteria are: 1. Relevance of aims 2. Method 3. Research design 4. Sampling method 5. Quality of data collection 6. Reflexivity 7. Research ethics 8. Accuracy of data analysis 9. Clarity of findings 10. Overall value of the research. In this tool, each article progresses to the next stage based on the score or grade obtained. The scoring and grading of CASP is categorized as poor (score of 0 to 10), moderate (score of 11 to 20), good (score of 21 to 30), very good (score of 31 to 40), and excellent (score of 41 to 50). Table 4 was utilized for scoring the articles based on the CASP criteria. In this research, the CASP (Critical Appraisal Skills Programmed) tool was used to assess the quality of studies in the systematic review process. This tool helps researchers select credible and reliable studies from the available literature and ensures that only high-quality studies are included in the final analysis. Below are the steps taken to use the CASP tool in this research and its criteria summarized:

Steps for Using the CASP Tool in This Research:

1. **Article Search:** Initially, articles related to the research topic (social responsibility accounting and reducing environmental impacts) were collected from various databases. In this research, 178 preliminary articles were identified.



2. Initial Screening: After the search, the articles were screened based on inclusion and exclusion criteria (such as the language of the article, year of publication, and topic relevance). At this stage, 129 articles were selected for further review.
3. Quality Assessment with CASP: The CASP tool was used to assess the quality of the remaining articles. This tool helped researchers select articles that are valid in terms of methodology, research design, and data analysis.
4. Scoring and Final Selection: Each article was scored based on the CASP criteria. Articles that received high scores (usually above 40 out of 50) were chosen for final analysis. Ultimately, 16 articles were selected as valid and reliable sources for extracting components of social responsibility accounting.

CASP Criteria in This Research

The CASP tool consists of 10 main criteria, based on which each article is evaluated. These criteria include:

1. Research Objectives: Are the research objectives clearly stated and relevant to the research question?
2. Methodology: Is the research methodology appropriate and suitable for the research objectives?
3. Research Design: Is the research design appropriately selected, and can it answer the research question?
4. Sampling Method: Is the sampling method appropriate, and has sampling been carried out correctly?
5. Data Collection Quality: Were the data collected in a valid and reliable manner?
6. Reflexivity: Have the researchers considered their impact on the research process and results?
7. Ethical Considerations: Were ethical considerations adhered to in the research?
8. Data Analysis Accuracy: Was the data analysis performed correctly, and are the results obtained valid?
9. Clarity of Findings: Are the findings clearly presented, and do they align with the research objectives?
10. Overall Value of Research: Does the research have scientific value overall, and can it contribute to the existing knowledge in the field?

Scoring Methodology in This Research

Each criterion was evaluated on a 5-point scale (0 to 5). The total scores obtained from each article determined its overall quality. For example:

- 0 to 10: Poor
- 11 to 20: Average
- 21 to 30: Good
- 31 to 40: Very Good
- 41 to 50: Excellent

In this research, articles that scored above 40 were selected as credible and reliable articles.

**Table 4.** CASP Criteria for Scoring Accepted Articles

Article Title	Research Objectives	Method Logic	Research Plan	Sampling Method	Data Collection	Reflectivity	Ethical Consideration	Accuracy of Data Analysis	Clear & Concise	Value of Research	Points Earned	Status	Row
Corporate Social Responsibility in IT Industry	4	5	5	5	5	4	5	5	5	5	48	Accepted	1
Corporate Share Values: Exploring CSR in Developing Rural Areas	5	4	5	5	5	4	5	5	4	5	47	Accepted	2
Analysis of the Impact of Corporate Social Responsibility on Corporate Competitiveness	4	5	5	4	4	5	5	4	5	5	47	Accepted	3
Corporate Social Responsibility and Customer Loyalty: A Review of Literature	4	5	4	4	4	5	5	5	4	5	45	Accepted	4
Human Rights and Corporate Accountability: Advocating for Corporate Social Responsibility	4	4	4	5	4	4	4	5	5	5	44	Accepted	5
Corporate Social Responsibility and Capital Structure	5	4	5	5	5	5	5	4	5	5	48	Accepted	6
The Impact of Social Norms of Responsibility on Corporate Social Responsibility	5	5	4	4	5	4	5	4	5	5	46	Accepted	7
Contemporary Challenges of Corporate Social Responsibility in Georgia	5	5	4	4	5	4	4	5	4	4	44	Accepted	8
Methods for Assessing Corporate Social Responsibility in the Retail Business	4	4	4	4	5	4	4	4	5	5	43	Accepted	9
The Effect of Corporate Governance on Tax Avoidance with CSR as Mediation	5	5	5	5	4	4	4	4	5	5	46	Accepted	10
A Virtuous Circle Brought About by CSR: A Study of the Dynamic Relationship between Social Capital, Social Responsibility, and Corporate Behavior	5	4	4	4	4	4	5	4	4	4	42	Accepted	11
Corporate Governance and Social Responsibility	5	5	5	5	4	4	5	5	4	5	45	Accepted	12
Corporate Social Responsibility Management	5	5	4	5	4	4	5	5	5	4	46	Accepted	13
An Analysis of the Differences and Similarities between Social Entrepreneurship and CSR	4	5	5	4	5	5	5	4	5	5	47	Accepted	14
Firm Performance, CSR Disclosure, and the Effect of Corporate Reputation and Governance: A Cross-Country Analysis	4	4	5	4	4	4	5	4	5	4	43	Accepted	15

Step 4: Extracting Information from Articles

In this stage, the content of the articles was carefully studied, and essential indicators were extracted. Specifically, after identifying the research questions, resources were identified through the selection of keywords and the search for these terms. Following the confirmation of documents based on the established entry criteria, data extraction was performed. The systematic review question in this research is: What are the components of social responsibility accounting aimed at minimizing adverse environmental impacts? To answer this question, a search was conducted according to the keywords selected in the previous steps, ultimately identifying 16 sources from a total of 178 sources for indicator extraction.

Step 5: Analyzing and Synthesizing Qualitative Findings

The most crucial part of qualitative research using a systematic review method occurs in this step. In this phase, the indicators derived from the 16 articles were identified. The scores they received, as derived from the CASP table, are also included.



Step 6: Reliability and Validity of the Model (Quality Control)

In qualitative research, the term validity encompasses concepts such as defensibility, credibility, conformability, and even the reflexivity of the results achieved. One indicator of reliability in qualitative research is the evaluation of two or more documents concerning a specific criterion. Reliability can be assessed by calculating the Kappa statistic, as validity means that the scale and content of the questions accurately measure the variables and topics under investigation. Kappa is considered the most appropriate and reliable method for examining and estimating agreement among observations (Armitage et al., 2012). To assess and evaluate a questionnaire or any measurement tool, the criterion of validity is utilized. If it meets this criterion, it indicates that the researcher's error rate in measuring the specified criteria and factors has been minimized. The reliability of the meta-analysis section of the research was re-evaluated with the assistance of four experts in this field and was conducted using Cohen's Kappa statistic. The calculated Kappa coefficient was found to be 0.78, indicating an adequate validity of the systematic review method. The formula for Cohen's Kappa is as follows:

$$K = \frac{PO - Pe}{1 - Pe}$$

Where PO represents the proportion of units of agreement, and Pe represents the proportion of units where random agreement is expected. It is important to note that this statistic always ranges between zero and one. A value of zero indicates complete disagreement between the two coders, while a value of one indicates the highest level of agreement. A Kappa coefficient value above 0.9 signifies the highest level of agreement among coders. A suitable Kappa reliability coefficient is considered to be above 0.6. Other interpretations of the Kappa coefficient values are as follows:

1. A coefficient value between 0 and 0.2 indicates 0 to 4% reliability in qualitative analysis.
2. A coefficient value between 0.21-0.39 indicates 4% to 15% validity of the qualitative analysis.
3. A coefficient value between 0.40-0.59 indicates 15% to 35% validity of the qualitative analysis.
4. A coefficient value between 0.60-0.79 indicates 35% to 63% validity of the qualitative analysis.
5. A coefficient value between 0.80-0.90 indicates 64% to 81% validity of the qualitative analysis.
6. A coefficient value greater than 0.9 indicates 82% to 100% validity of the qualitative analysis.

Step 7: Combining, interpreting, and reporting data

In this step, a list of social responsibility accounting components is first compiled with the aim of minimizing harmful effects on the environment, as shown in Table 5 below.

Tabula 5. Elementa Rationis Socialis Responsabilitatis

Rangs	Elementum
1	Gradus Responsabilitatis Socialis
2	Indices Progressus Sustentabilis
3	Activitates Inusitatae
4	Caput Creditorium
5	Aestimatio Effectuum Activitatum Ambientalium
6	Perspicuitas in Finibus Rationis Socialis Responsabilitatis
7	Interactio et Communicatio cum Stakeholderis
8	Integratio Rationis Socialis Responsabilitatis in Programmata et Budgeto
9	Creando Responsabilitatem Socialem in Omnibus Gradibus Organizationis
10	Gradus Performance Systematis Rationis Socialis Responsabilitatis
11	Gradus Impensarum et Investmentorum in Activitatibus Socialibus
12	Gradus Valoribus Generatis ex Responsabilitate Sociali

Quantitative Data Analysis

Quantitative data analysis was conducted to optimize the components of social responsibility accounting with the aim of minimizing environmental harm at Ilam International Cement Company. The Gray Wolf feature selection algorithm was applied with adjusted parameters to identify the most



relevant components of social responsibility accounting. Subsequently, a Likert-scale questionnaire was administered to the sample group, and the descriptive statistics are presented in the table below.

Table 6. Descriptive Statistics of Respondents

Characteristic	Count	Frequency	Characteristic	Count	Frequency
Gender			Organizational Department		
Male	21	68%	Finance and Accounting	10	38%
Female	5	32%	Production and operations	8	31%
Total	26	100%	Environment and Sustainability	4	15%
Educational Degree			Human Resources	3	12%
Master's Degree	18	76%	Other Departments	1	4%
Doctorate	8	24%	Total	26	100%
Total	26	100%			
Age Group	Count	Frequency	Work Experience in Company	Count	Frequency
Less than 30 years	8	31%	Less than 5 years	6	23%
to 40 years	12	46%	to 10 years	12	46%
to 50 years	5	19%	to 15 years	5	19%
More than 50 years	1	4%	More than 15 years	3	12%
Total	26	100%	Total	26	100%
Job Role in Company	5	19%			
Senior Manager	7	27%			
Deputy	10	38%			
Specialist/Expert	4	15%			
Total	26	100%			

According to the objective functions formulated in the algorithm section shown in Table 7 below.

Table 7. Values of Objective Functions

	Objective Functions
Min $z_1 = y_{fit}$ $z_1 = y_{\text{fit}}$	Objective Function (1)
Min $z_2 = N_f$ $z_2 = N_f$	Objective Function (2)

Parameter Configuration of the Algorithm

To configure some parameters of the proposed algorithm, the Taguchi method for experimental design and analysis in the MINITAB software environment have been utilized. The parameters include the population size of wolves, the number of neighborhood search iterations, and the number of algorithm iterations in the gray wolf optimization algorithm. For configuring the parameters of the gray wolf algorithm, the values of each of these parameters have been examined at three levels, which are presented in the table below.

Table 8 - Levels of Parameters for the Gray Wolf Algorithm

Neighborhood Search Iterations	Population Size	Algorithm Iterations
5	70	150
10	150	300
15	200	500

To perform the analysis, a criterion named GAP has been designed, and the method of its calculation is shown below.

$$GAP = \left(\sum \frac{alg_{sol} - Best_{sol}}{Best_{sol}} \right) \times 100$$

Algsol: The value of each objective function obtained for the problem with the specified combination of parameters.



Bestsol: The best value of the objective function obtained from among the values of all combinations for the problem.

In fact, the problem has been executed for each of the combinations mentioned above, and the GAP criterion has been calculated for each problem, with the corresponding chart ultimately being plotted. For parameter configuration, the Taguchi method for experimental design has been utilized with the 9L approach. The orthogonal table for the algorithm is shown below.

Table 9. Orthogonal Table for Configuring Parameters of the Gray Wolf Algorithm

Experiment Number	Neighborhood Search Iterations	Population Size	Algorithm Iterations	GAP Value
1	5	70	150	0.2341
2	5	150	300	0.4367
3	5	200	500	0.3395
4	10	70	300	0.3083
5	10	150	500	0.1285
6	10	200	150	0.2216
7	15	70	500	0.1993
8	15	150	150	0.4643
9	15	200	300	0.2942

The results from the MATLAB software are shown in the charts below.

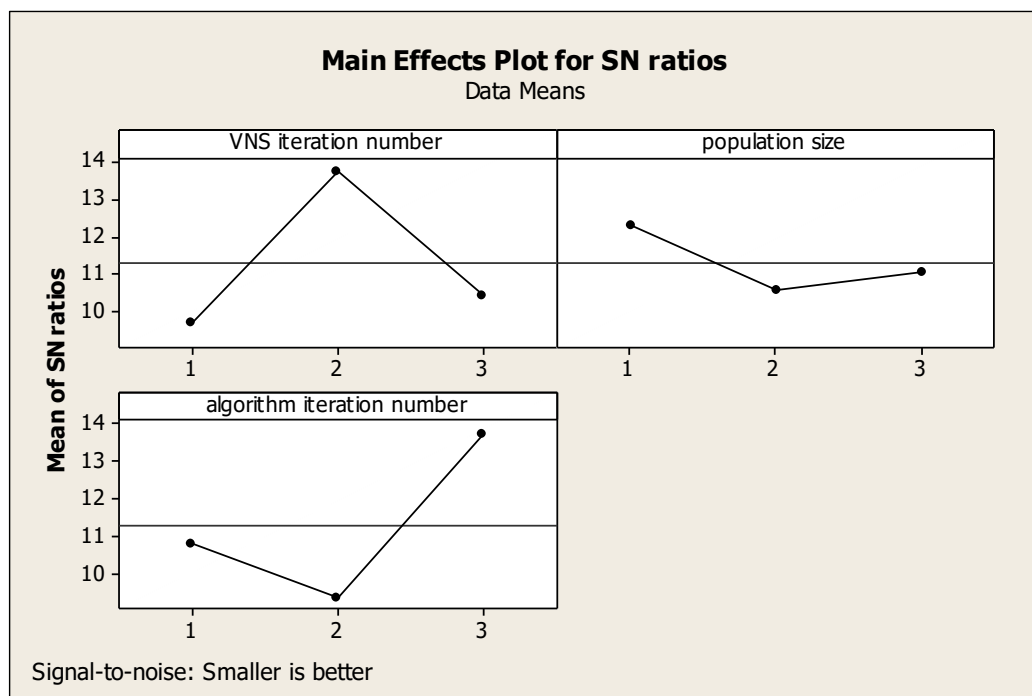


Figure 2. Signal-to-Noise Ratio (SNR)

The signal-to-noise ratio (SNR) is defined as the ratio of the power of a signal to the power of the noise present in that signal. It is a measure used to express the optimal performance of a system processing objective functions, provided that the noise is Gaussian. The SNR compares the power level of the signal to the power level of the noise, and it is typically expressed in terms of factors and components. A higher SNR value indicates a better characteristic for a given system, as it means that more useful information is received in the form of the signal compared to unwanted information or noise.

**Table 10.** Results of the Gray Wolf Algorithm

Row	Factors	Iterations	Population	Objective Function Value (1)	Objective Function Value (2)
1	Level of Social Responsibility	500	150	1.53	39
2	Sustainable Development Indicators	300	50	0.9777	30
3	Unusual Activities	200	150	1.59	41
4	Credit Capital	150	100	0.986	29
5	Estimation of Environmental Activity Impacts	500	150	0.967	33
6	Transparency in Social Responsibility Accounting Goals	300	70	1.18	44
7	Interaction and Communication with Stakeholders	300	200	1.34	43
8	Integration of Social Responsibility Accounting into Programs and Budgets	300	100	1.66	46
9	Establishing Social Responsibility at All Levels of the Organization	150	150	0.994	40
10	Performance Level of Social Responsibility Accounting System	500	70	0.98	28
11	Level of Costs and Investments in Social Activities	300	50	1.76	48
12	Value Created from Social Responsibility	500	200	0.953	32

According to the results obtained in the above table, the factors for which the value in the first objective function is greater than one and also have higher values in the second objective function compared to other factors have been identified as components of social responsibility accounting aimed at minimizing harmful impacts on the environment in the Ilam International Cement Company, which are shown in Table 11 below.

Table 11. Components of Social Responsibility Accounting Aimed at Minimizing Harmful Environmental Impacts

Row	Factors	Iterations	Population	Objective Function Value (1)	Objective Function Value (2)
1	Level of Social Responsibility	500	150	1.53	39
2	Unusual Activities	200	150	1.59	41
3	Transparency in Social Responsibility Accounting Goals	300	70	1.18	44
4	Interaction and Communication with Stakeholders	300	200	1.34	43
5	Integration of Social Responsibility Accounting into Programs and Budgets	300	100	1.66	46
6	Level of Costs and Investments in Social Activities	300	50	1.76	48

As observed in the table above, six factors that have a value greater than one in the first objective function and a higher value than other factors in the second objective function are identified as components of social responsibility accounting aimed at minimizing harmful environmental impacts in the Ilam International Cement Company. These components are positioned under optimal conditions and at the maximum possible values.

Discussion and Conclusion

In the present era, accounting goes beyond the mere recording of numbers and plays a vital role in shaping the social responsibility of organizations. This concept acts as a bridge between the financial and ethical worlds, referring to the accounting profession's commitment to society and the environment. Social responsibility in accounting includes transparent and comprehensive reporting on the social and environmental impacts of an organization's activities. This approach requires accountants to assess and report on the sustainability performance of companies beyond traditional financial statements. Through environmental accounting, the costs and benefits of organizations' environmental actions are quantified



and disclosed, leading to more informed decision-making. Furthermore, social responsibility in accounting encompasses the provision of non-financial information such as employee working conditions, diversity and inclusion policies, and engagement with local communities. This information provides a more comprehensive picture of the organization's performance and enables stakeholders to assess the overall impact of the organization on society.

This research aimed to identify and optimize the components of social responsibility accounting with the goal of minimizing harmful environmental impacts in the Ilam International Cement Company. This study differs significantly from previous research, some of which are highlighted below. The research by Wijaya et al. (2024) examined the company's stock values and corporate social responsibility simultaneously but in separate areas. In contrast, this study not only identified the components of social responsibility accounting but also optimized them. The research by Sun (2024) explored the impact of corporate social responsibility on company competitiveness, which was purely quantitative. In contrast, this study utilized mixed-method data (qualitative-quantitative) to demonstrate corporate social responsibility at its highest level. The research by Kamali Rad and Shakeri (2024) examined the impact of social responsibility and service quality on customer satisfaction in import-export and customs companies in Bushehr province. The data for this study were collected using questionnaires and a Likert scale, while this study gathered qualitative data from previous research and then collected quantitative data through a questionnaire based on the qualitative component. The research by Ahmadi et al. (2024) investigated the moderating effect of ownership concentration on the relationship between the level of social responsibility disclosure and company reputation. The quantitative data were collected, whereas this study gathered qualitative data from previous studies and then compiled the quantitative data using a questionnaire to formulate the optimal state. This research ultimately demonstrated that social responsibility in accounting symbolizes the evolution of this profession; a movement from merely recording the past to shaping a more sustainable and responsible future. This approach transforms accounting into a powerful tool for positive change in society and highlights the vital role of this profession in building a better world.

The findings of this research have significant implications both theoretically and practically. Below, we explore these implications and how the optimization of social responsibility accounting components can contribute to broader discussions on Corporate Social Responsibility (CSR).

Theoretical Implications

1. **Development of Theoretical Frameworks in Social Responsibility Accounting:** This research contributes to the development of theoretical frameworks in social responsibility accounting by identifying and optimizing its components. The findings demonstrate how advanced algorithms, such as the Grey Wolf Optimizer (GWO), can be used to enhance the environmental and social performance of companies. This can serve as a foundation for future research on integrating artificial intelligence technologies and optimization algorithms into social responsibility accounting.
2. **Link Between Social Responsibility Accounting and Environmental Sustainability :** This research shows that social responsibility accounting can serve as a powerful tool for measuring and reporting the environmental impacts of companies. These findings strengthen existing theories on the relationship between social responsibility and environmental sustainability, demonstrating how companies can improve their environmental performance through transparent and accurate reporting.
3. **Development of Quantitative Models for Assessing Social Responsibility:** The use of the Grey Wolf Optimizer to optimize social responsibility accounting components highlights the potential for developing new quantitative models to evaluate and improve the social and environmental performance of companies. These models can serve as tools for researchers and managers to more accurately assess the social and environmental impacts of corporate activities.

Practical Implications

1. **Improving Companies' Environmental Performance:** The findings of this research indicate that optimizing social responsibility accounting components can help companies reduce their negative



environmental impacts. This is particularly important for industries such as cement, which have significant environmental footprints. Companies can use these findings to design more effective strategies for reducing pollution and natural resource consumption.

2. **Enhancing Transparency and Public Trust:** Transparency in social responsibility reporting can increase public trust. This research demonstrates how companies can gain stakeholder trust by transparently publishing their environmental goals and results. This can improve relationships with local communities, governments, and non-governmental organizations.
3. **Reducing Costs and Increasing Profitability:** Optimizing social responsibility accounting components can help companies reduce costs associated with pollution and environmental fines. Additionally, investing in social and environmental activities can enhance brand image and lead to long-term profitability.
4. **Facilitating Compliance with Laws and Regulations:** Given the increasing number of environmental regulations at national and international levels, optimizing social responsibility accounting components can help companies comply with these laws and avoid legal penalties.

Contribution to Broader Discussions on Corporate Social Responsibility

1. **Link Between Social Responsibility and Sustainability:** This research demonstrates that social responsibility is not limited to charitable activities but also includes practical actions to reduce negative environmental impacts and improve sustainability. This contributes to broader discussions on the role of companies in achieving Sustainable Development Goals (SDGs).
2. **The Role of Technology in Social Responsibility:** The use of advanced algorithms such as the Grey Wolf Optimizer highlights how technology can serve as a powerful tool for improving corporate social responsibility. This can contribute to broader discussions on the role of modern technologies in assessing and enhancing the social and environmental performance of companies.
3. **The Impact of Social Responsibility on Corporate Competitiveness:** This research shows that companies that optimize their social responsibility can achieve a better position in competitive markets. This contributes to broader discussions on the link between social responsibility and corporate competitiveness, demonstrating how companies can create a competitive advantage by improving their social and environmental performance.
4. **The Role of Stakeholders in Social Responsibility:** This research emphasizes the importance of engaging stakeholders in the social responsibility process. This contributes to broader discussions on the role of stakeholders in shaping companies' social responsibility strategies, showing how companies can achieve better outcomes by involving stakeholders.

The limitations of this study are as follows and should be explicitly discussed

1. **Limitations Related to Purposive Sampling**
 - **Selection Bias:** This study used purposive sampling, which may lead to bias in sample selection. This sampling method is based on the researcher's judgment and may result in samples that do not fully represent the entire population. Specifically, selecting managers and experts familiar with social responsibility accounting may lead to results that do not fully reflect the perspectives of all stakeholders.
 - **Lack of Generalizability:** Due to the use of purposive sampling, the results of this study may not be fully generalizable to other organizations or industries. This limitation is particularly evident for companies operating in different industries or geographical regions.
2. **Limitations Related to Self-Reported Data**



- Respondent Bias: The data collected through questionnaires are self-reported, which may be influenced by respondent biases. For example, respondents may tend to provide socially desirable answers or may not disclose their true opinions due to fear of negative consequences.
- Perceptual Errors: Respondents may not have a precise understanding of social responsibility accounting concepts or may misinterpret questionnaire questions. This could lead to inaccurate or incomplete responses, negatively affecting data quality.
- Inaccurate Reporting: Some respondents may not provide accurate answers due to time constraints or unwillingness to fully participate. This could result in incomplete or incorrect data, impacting the study's results.

3. Limitations Related to Research Methodology

- Reliance on Qualitative and Quantitative Data: This study used mixed methods (qualitative and quantitative), which, while advantageous, may lead to complexity in data analysis. Additionally, interpreting mixed results can be challenging and requires greater care in generalizing findings.
- Use of the Grey Wolf Optimizer (GWO): Although this algorithm was chosen for its high accuracy and convergence speed, its use may have limitations. For example, the algorithm may not perform optimally with complex or noisy data. Additionally, parameter tuning may affect the results, requiring greater care in their interpretation.

4. Limitations Related to the Study Context

- Focus on a Specific Company: This study focused on the Ilam International Cement Company, which may limit the generalizability of its results to other companies or industries. Companies in other industries may face different challenges and conditions, requiring different approaches to social responsibility accounting.
- Cultural and Legal Context: The specific cultural and legal context of Iran may have influenced the study's results. For example, environmental laws and social expectations in Iran may differ from those in other countries, which could affect the generalizability of the results to other regions.

5. Limitations Related to Time and Resources

- Time Constraints: Conducting this study within a specific time frame may have influenced its results. For example, changes in environmental laws or economic conditions could affect the implementation of social responsibility accounting.
- Resource Constraints: Access to complete and up-to-date data and information resources may have been limited. This could impact the quality and accuracy of the study's results.

Despite providing valuable insights into optimizing the components of social responsibility accounting, this study has limitations that must be considered when interpreting and generalizing its results. To mitigate these limitations, future studies are recommended to use random sampling methods, collect data from more diverse sources, and employ different optimization algorithms. Additionally, conducting similar studies in other industries and geographical regions could enhance the understanding of the application of social responsibility accounting.

Practical Recommendations

1. Organizations should establish quantitative measurement systems to assess their level of social responsibility. These systems should be designed to continuously monitor and improve the organization's social and environmental performance (Level of Social Responsibility.)



2. Environmental improvement activities that are carried out unusually should be financially evaluated, and their positive impacts should also be quantitatively reported (Unusual Activities).
3. Organizations should transparently and accessibly publish their social responsibility accounting objectives for stakeholders to increase public trust (Transparency in Social Responsibility Accounting Objectives).
4. Creating interactive mechanisms with stakeholders can help organizations better understand the needs and expectations of the community and incorporate them into their planning processes (Interaction and Communication with Stakeholders).
5. Organizations should fully integrate social responsibility accounting into their planning and budgeting processes to ensure that social and environmental goals are pursued simultaneously with financial objectives (Integration of Social Responsibility Accounting into Planning and Budgeting).

The following practical recommendations outline actions that companies like Ilam International Cement can immediately take to improve their performance in social responsibility accounting and reduce negative environmental impacts:

1. Companies should establish systems for continuously measuring and monitoring their social and environmental performance. These systems should include key performance indicators (KPIs) that are regularly reviewed and updated. Ilam International Cement can measure and report indicators such as greenhouse gas emission reductions, energy and water consumption, and material recycling rates.
2. Companies should financially evaluate unusual environmental activities (such as special pollution reduction projects or the use of green technologies) and quantitatively report their positive impacts. Ilam International Cement can calculate and publish the costs and benefits of using alternative fuels or emission reduction technologies in their annual reports.
3. Companies should transparently and accessibly publish their social responsibility accounting goals and results for stakeholders. This can increase public trust. Ilam International Cement can clearly announce its environmental goals (such as a 20% reduction in CO₂ emissions by 2025) on the company website and in annual reports.
4. Companies should create interactive processes with stakeholders (such as local communities, government, and non-governmental organizations) to better understand their needs and expectations and incorporate them into their planning. Ilam International Cement can hold regular meetings with local community representatives and environmental organizations to include their feedback in environmental programs.
5. Companies should fully integrate social responsibility accounting into their planning and budgeting processes to ensure that social and environmental goals are pursued alongside financial objectives. Ilam International Cement can allocate a portion of its annual budget to environmental and social projects and regularly monitor their progress.
6. Companies should identify and implement advanced technologies that help reduce environmental impacts. These technologies can include energy management systems, emission reduction technologies, and recycling methods. Ilam International Cement can use new technologies such as high-efficiency kilns or carbon capture systems to reduce greenhouse gas emissions.
7. Companies should conduct regular training programs for employees on social responsibility and environmental issues to increase their awareness and engagement. Ilam International Cement can organize workshops on energy-saving methods and waste management for its employees.



8. Companies should prepare and publish regular, transparent reports on their social and environmental performance. These reports should include both quantitative and qualitative data so stakeholders can easily evaluate them. Ilam International Cement can publish quarterly or annual reports on the progress of its environmental and social projects.
9. Companies should collaborate with environmental organizations and research centers to benefit from the latest technologies and methods for reducing environmental impacts. Ilam International Cement can partner with universities or research institutions to conduct research projects on pollution reduction and energy efficiency improvement.

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