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The impact of climate risk disclosure on financial performance, financial reporting and risk management: evidence from Egypt

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Abstract

Where Egypt stand with climate related-risk disclosures and why stakeholders and organizations require such information? This research aims to measure the climate risk disclosure level in Egyptian companies and to investigate its determinants. As unfavorable climatic circumstances create systemic risk for businesses throughout the whole global economy, this research examine how the disclosure of climate change risks affects the financial performance, financial reporting, and risk management. Few studies analyze how climate-related risk affects the financial performance of publicly traded companies in Egypt. This research applies regression models using both quantitative and qualitative methodologies. The information was gleaned from the 2019 through 2022 financial statements of 25 publicly traded companies. According to statistical analysis, there is a significant positive association between the financial performance, financial reporting, and risk management of industrial organizations and the disclosure of climate change. The findings show that the financial markets require precise, thorough, and high-quality information about the effects of climate change. This encompasses the threats and chances posed by increasing temperatures, climate-related legislation, and new technology in our rapidly evolving global environment.

Keywords Climate risk disclosure, Financial performance, Financial reporting, Risk management, Egypt

Introduction

Governments, investors, and other stakeholders are paying increasing attention to climate change as its repercussions become more obvious. Physical hazards and transitional risks are two examples of these consequences, and they can have an effect on the operations of organizations of all sizes and types, including those with large carbon emissions [7].

Only a few researchers have specifically addressed the issues related to climate change, despite the fact that the issue of climate change is a recent development under the umbrella of "environmental reporting" [16]. The majority of researchers have looked into the different dimensions of environmental disclosures made by the firms [11, 47].

Companies will be impacted by climate-related difficulties in diverse ways, but investors believe that a wide spectrum of firms will be affected. Companies and investors that are addressing and thinking about climate-related concerns understand the benefits that come from a thorough analysis of the challenges the company will face in the future, as well as the linked advantage of feeling better prepared to respond and reposition the firm as necessary.

Entities should consider how climate change, including their pledges and activities to address climate change, may influence their financial statements and other reporting responsibilities as investors concentrate more attention on climate-related issues [43]. For instance, organizations agree to adopt net-zero or other climate goals and develop a climate strategy that includes

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a transition strategy, their financial statements may be directly impacted by these plans and objectives.

Users of financial statements anticipate corporations to provide clear and open disclosures regarding climate change. Entities should take into account both the general requirements of IAS 1 "Presentation of Financial Statements" and the specific disclosure requirements in individual IFRS Accounting Standards in order to fulfill these expectations [34, 57, 60].

Companies should start by considering materiality. According to IAS 1, an item is considered significant if it has the potential to individually or collectively affect the economic judgments that users base their choices on. This information in the financial statements is projected to become more important as investors take climate change factors into account when making capital allocation choices [2].

Companies should disclose both qualitative and quantitative information about climate risks and their impact on their financial statements if this information is important to investors.

Investors rely on a variety of corporate reporting, including financial reporting, to understand the possibilities and hazards associated with climate change for businesses and to assist them in allocating capital. Investors keep requesting that the caliber of this reporting be improved. In order to create a comprehensive global baseline of high-quality sustainability disclosure standards, the IFRS Foundation announced the creation of the International Sustainability Standards Board (ISSB) [20, 34]. This announcement serves as a reminder to preparers of the importance of full, consistent, and full disclosure of material climate and sustainability-related data across standard annual reporting, including the financial statements.

The company should clarify in its reporting how it has taken into account the resilience of its business model as well as the risks, uncertainties, and viability of the model over the short- and long-terms in light of climate change [58]. Companies should also take into account the current and potential effects of climate change on their financial position when valuing their assets, making assumptions for impairment tests, determining depreciation rates, and disclosing financial risk information [25].

Climate-related risks can have a major impact on the assets and liabilities of some companies, even though financial statements typically only contain a small amount of forward-looking information.

For example, companies should disclose how they have taken climate-related risks into account when estimating the value of their assets.

However, climate risks and opportunities may impact several areas of an entity's financial statements. There are currently no clear IFRS accounting standards on climate-related matters, but companies are still expected to disclose information about climate risks if it is material to investors.

Even if the immediate impact on financial statements is not necessarily quantitatively significant, many stakeholders expect entities to qualitatively explain in their annual reports how climate-related issues are accounted for [45, 49]. The major financial regulators and standard-setters, ASIC, APRA, and the ASX Corporate Governance Council, have all recently released guidance emphasizing the importance of taking climate change into account, not just as a matter of corporate sustainability reported outside of annual reports but as a matter that should be taken into account as part of the preparation of the annual reports. According to guidelines created in collaboration between the AuASB and the AASB, it is necessary to explain how significant climate risks have been taken into account in the financial statements and are consequently subject to audit [54].

The Financial Stability Board (FSB) is committed to addressing the financial risks posed by climate change. They believe that it is important for companies to publicly disclose their climate-related financial risks in a way that is consistent, comparable, and useful for decision-making. This will help to identify vulnerabilities in the financial system.

Some investors place a strong emphasis on how crucial it is for businesses to take into account how climate change may affect their financial statements, given that this data will be audited. In order to appraise businesses and decide how much cash to allocate, they also require this key knowledge.

The International Auditing and Assurance Standards Board additionally responded to the growing influence of climate-related issues on the audit of financial statements by issuing a staff audit practice alert that is meant to assist auditors in comprehending how an auditor will take into account climate-related risks in an audit of financial statements. The rising impact of climate change and the possible hazards of financial statement misstatements have been noted by financial auditors, who have begun to highlight this in important audit items in their reports, IAASB [33]. Promoting financial disclosures connected to climate change is a concern for the whole reporting supply chain. The International Auditing and Assurance Standards Board recognized management, users, those in charge of governance, regulators, and auditors as members of the reporting supply chain. Interactions between these groups may improve the report's quality [26, 59].

The significance of financial disclosures connected to climate change is being increasingly understood. Regulatory changes, land use changes, water scarcity,

disruptions in supply chains, and weather-related changes at key production locations are just a few of the issues that businesses may face. Understanding what each may imply for the company is crucial since it makes the connection to strategic planning.

The research issue is becoming increasingly included in standards-setting, regulations, and guidelines. In contrast to the demands or suggestions made by regulatory agencies, there is a substantial gap between the disclosures made by firms. The lack of adequate integration of climate change risk and opportunity into fundamental business processes and operations appears to be a contributing factor in this. There is a need for further initiatives to support excellent financial reporting connected to climate change [48].

Climate change is causing more frequent and severe events and disasters. This requires governments, businesses, and other organizations to work together to respond effectively. Businesses must disclose information to stakeholders about their efforts to mitigate the effects of climate change and the risks associated with it. The need for climate-related financial disclosure is becoming more widely recognized; nonetheless, many organizations are still failing to execute it effectively. As a result, more guidance on how to properly implement climate-based financial disclosure is required [8].

The purpose of this research is to promote climate-related disclosure as well as enhance its relevance, reliability, and comparability. The Financial Stability Board (FSB) urges enterprises to continue providing climate-related financial disclosures in accordance with the recommendations of the TCFD. This will make it easier for corporations to utilize a standard framework and make their disclosures more relevant to investors and other interested parties.

This research contributes to previous academic studies on Climate Risk Disclosure (CRD). Despite the lack of standardized methodology for evaluating links between CRD, financial performance, and financial reporting, some research has shown a positive association, while others have found a neutral or negative relationship. This research contributes to the growing corpus of research on corporate risk management and climate risk disclosure by investigating the relationship between CRD and company financial performance for 25 Egyptian stock exchange firms from 2019 to 2022.

According to the researchers, when companies are forced to report climate-based financial risks on their public financial statements, they will need to better align their climate-risk experts with their finance function, which is important because better climate-based financial risk management can improve financial performance [66].

The researchers argue that climate-based financial risks are intricate and necessitate the expertise of both climate-risk specialists and financial professionals. By mandating companies to provide information regarding their financial risks, they can be encouraged to collaborate in order to gain a better understanding and management of these risks. This is of great importance, as the financial implications of climate-related risks are becoming increasingly apparent for both companies and investors alike. By managing their financial risks more effectively, companies can enhance their financial performance, and investors can be better equipped to make sound investment decisions.

The financial implications of climate-related risks for non-financial institutions are not always readily apparent, and there are difficulties associated with the assessment, quantification, and management of these risks. Nevertheless, financial executives (such as Chief Financial Officers, Chief Accounting Officers, and Chief Compliance Officers) should be cognizant of the fact that the recommendations for climate risk disclosure should lead to more quantifiable financial disclosure of the financial implications climate-related risks could have on organizations [46]. Specifically, climate change could result in asset impairments and additional liabilities resulting from regulatory fines and sanctions, as well as a potential impact on net income, cash flow from operations, and capital access.

Financial executives must be involved in the assessment of the potential risks and opportunities posed by climate change and the measures taken to manage those risks and maximize those opportunities. To ensure that climate-related financial disclosure is consistent, comparable, and reliable, it is essential to provide a level of detail that allows users to compare and understand the risks of different organizations [64]. This level of detail must be sufficient to make it possible to compare across sectors and across the entirety of the portfolio. Climate change is a global issue that affects all aspects of the economy, and organizations should be able to provide transparency to investors and other interested parties in order to enable them to make informed decisions regarding risk allocation and investments [15].

In conclusion, climate change affects all economic sectors, but the level of exposure and impact differs depending on the sector, industry, and geography. The financial impacts of climate change are not always clear or Consistent, comparable, and reliable disclosures also help to promote market transparency and efficiency. By making it easier for investors to compare the risks faced by different organizations, disclosures can help reduce the cost of capital for organizations that are managing their climate-related risks effectively.

Overall, this research highlights the importance of high-quality climate-related financial disclosures for both organizations and their stakeholders [28], and it can be challenging for organizations to identify, assess, and report on these impacts [63]. This can be the cause of many factors, including:

This may be result of many factors, including

- Limited knowledge of climate-related issues within organizations.
- A tendency to focus on near-term risks at the expense of longer-term risks.
- The difficulty of quantifying climate-related risks.

Better disclosure of the financial impacts of climate-related risks and opportunities is important for investors, lenders, and insurance underwriters to make informed financial decisions. They need to understand how climate change affects and is likely to affect an organization's future financial performance and position.

Climate risk disclosure in the context of Egypt

Egyptian non-financial institutions are facing increasing pressure from investors, regulators, consumers, and other stakeholders to identify, assess, and mitigate climate-related risks. These risks can result from policy and market shifts to green economic models as well as physical risks, including water stress, increased flood risk, and precipitation variations.

The implementation of climate risk disclosure in Egypt is still in its infancy. According to a 2022 study conducted by the International Finance Corporation, only ten percent of Egyptian companies reported any climate-related risk information in their financial statements, which is below the global average of twenty percent.

Stakeholders and organizations require climate risk disclosures for a variety of reasons. ***Firstly***, climate change poses a significant financial risk to businesses, as those that are not adequately prepared could incur significant losses due to property damage, operational disruptions, and alterations in customer preferences. ***Secondly***, climate change presents a systemic risk, meaning that it could have a wide-reaching impact on the financial system if a significant number of companies were not adequately prepared. ***Finally***, investors need to be aware of the potential impacts of climate change on the companies they are investing in; lenders must be aware of how climate change could affect their borrowers' creditworthiness; and insurers must be aware of the likely impact of climate change on their claim risk.

The government of Egypt recognizes the importance of disclosing climate threats. This is reflected in the FRA's 2021 resolution, which requires all listed non-financial institutions to include climate-related data in their annual financial statements, with implementation set for 2023. Nevertheless, further efforts are necessary to encourage climate-related disclosure in Egypt, such as the FRA's proposal to make it a mandatory requirement for all companies regardless of their size or sector, as well as the government's financial and technical assistance to companies. By enhancing climate-related disclosure, Egyptian businesses can mitigate the financial risks associated with climate change and contribute to the sustainability of the economy.

Materiality and climate-related risk disclosure

IAS 1 adopts the concept of materiality in order to consider whether the financial statement disclosure may have an effect on the economic decisions of users. Different organizations will be impacted by climate-related challenges in different ways, but it is obvious that investors want to know how businesses have thought about how these issues can affect their business models, strategies, and other areas.

Companies should, at a minimum, consider the potential implications that climate-related concerns may have on their business model in order to determine whether they are relevant. Even if the result of the evaluation indicates that it is not substantial, investors want to know how the company arrived at that conclusion [37, 50].

Investors could view it as a major problem given the influence it would likely have on the company's future business plan. For instance, if a company sector is now only partially exposed to physical dangers but is a growing component of the enterprise, this might have a significant effect and may thus be regarded as substantial. Investors believe more businesses should declare climate change as a risk or, at a minimum, as an uncertainty in their primary risks and uncertainties disclosures. Investors are also curious about the hazards that businesses have recognized for themselves. Even in cases where climate risk has not been deemed a primary risk, it is expected that a corporation will describe how it evaluated the materiality of the risk. If a danger is identified, it should be explained what consequences give rise to that particular concern [24, 38].

Instead of considering the amount of the source data, materiality is evaluated from the viewpoint of the main users and the resource allocation choices they make. Information will generally be considered relevant to the financial statements if it has the potential to have an impact on the economic choices of the key users. Existing

and future investors, lenders, and other creditors are the main consumers [3, 25].

Methods

Development of hypotheses

Climate disclosure standards board

Eight environmental and business organizations make up the Climate Disclosure Standards Board (CDSB), including CDP, CERES, The Climate Group, Climate Registry, International Emissions Trading Association, World Council for Business and Sustainable Development, World Economic Forum, and World Resources Institute. A Technical Working Group composed of industry representatives, accounting organizations, the largest accounting firms, academics, and investors supports the organization. It aims to create and advance the CDSB Climate Change Reporting Framework to make it simpler for businesses to interact with one another and for investors to comprehend information about climate change in mainstream reports. The Climate Change Reporting Framework and other materials created by CDSB are intended to offer policymakers and other stakeholders' standard-ready documentation that will enable sound decision-making. Clarity, confidence in information, and increased market stability are the goals of its work [40, 57].

Sector-specific reporting standards have been developed by the TCFD for financial institutions, asset owners, asset managers, and other non-financial businesses such as transportation, materials and structures, energy, agriculture and food, and goods. The TCFD encourages businesses to assess the possible implications of climate change on their operations and develop plans to handle the risks and opportunities that may arise. Furthermore, the TCFD encourages businesses to be transparent about their climate-related actions and results [65].

Here are some specific things that companies can do to meet the TCFD recommendations

- Conduct a scenario analysis to evaluate the risks caused by climate change.
- Develop a climate change strategy that outlines how they will manage these risks and opportunities.
- Implement risk management processes to identify, assess, and mitigate climate-related risks.
- Set metrics and targets to track their progress on climate change.
- Disclose information about their climate-related activities and performance in their financial reporting.

By following the TCFD recommendations, companies can help ensure that they are prepared for the challenges and opportunities posed by climate change.

The TCFD released a report in 2020 [57] that outlined four fundamental components of suggested financial disclosures connected to climate change that apply to firms across all industries and jurisdictions, as shown in Fig. 1:

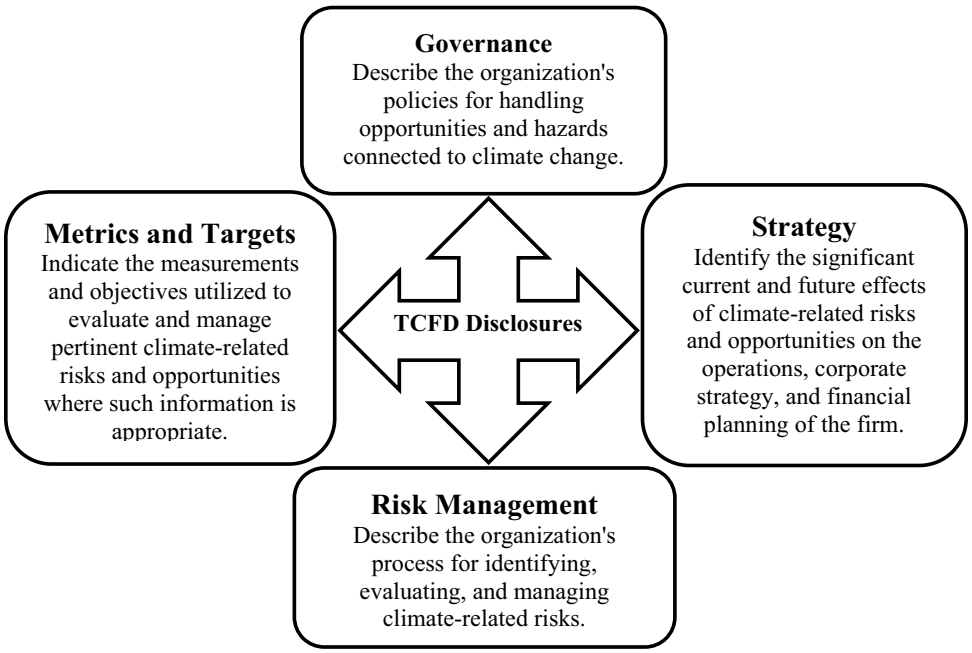

Fig. 1 TCFD recommended disclosures

1. Governance: The organization's governance of opportunities and hazards associated with climate change. Companies and investors emphasized the significance of the board's function. Investors emphasized the significance of comprehending how a board thinks about and evaluates climate-related concerns. By doing so, they are able to feel more at ease with the processes and the board's evaluation of how the business model and strategy of the firm are impacted. Investors desire greater details about how boards evaluate a variety of sustainability-related themes in the reporting, such as workforce difficulties connected to the company's business model and strategy and climate-related challenges.
2. Strategy: How the organization's operations, strategy, and financial planning are affected by current and future risks and opportunities connected to the climate. Due to the high degree of interdependence among the fields in which climate-related challenges may be significant, strategic planning must take into account input from each field. Given that challenges associated with climate change pose a challenge to strategy both now and in the future, board participation in determining the company's strategy is seen as essential.
3. Risk Management: The procedures the company uses to recognize, evaluate, and control climate-related hazards. Investors look for disclosures related to a firm that detail risk priority, likelihood, and effect. Investors would want to see more mention of climate-related problems throughout the risk and viability sections. Understanding the associated governance and risk management processes is crucial, regardless of how important they are.
4. Metrics and Targets: It is used to assess and manage both climate-related opportunities and risks. One of the most difficult aspects of climate reporting is the need to reflect on the future in an environment of uncertainty. Establishing objectives and measuring against them can help to evaluate performance and bolster management assurance; however, certain aspects of performance will become less pertinent due to their backward-looking nature. Metrics should align with strategy, be transparent, dependable, and consistent.

TCFD, financial performance, financial reporting, and risk management

The Task Force on Climate-Related Financial Disclosures (TCFD) is an international body that works to promote the disclosure of information on the financial implications of climate-related risks and opportunities. The TCFD was formed by the Financial Stability Board (FSB), which is an international body that seeks to strengthen and protect global financial markets.

The TCFD is a set of guidelines developed by a group of experts who recognized potential risks and opportunities related to climate change. The guidelines are founded on the idea that climate change is an important threat to the financial system and that if corporations fail to disclose the possible implications of climate change on their operations, investors and lenders may make unwise choices. Although recommendations are not mandatory, many businesses decide to adhere to them because they recognize the importance of being transparent and open about their climate-related risks and opportunities. Companies that follow the TCFD principles can help make the financial system able to adapt to the implications of climate change [17].

TCFD is central to the research issue in the following three aspects:

1. Financial Performance: Companies must be aware of the financial risks associated with climate change in order to provide investors and lenders with the information they need to make informed investment decisions. The TCFD outlines the requirements for companies to disclose information about their financial risks and opportunities related to climate change. Companies should take into account the current and potential financial implications of climate-related events on their income, expenses, assets, liabilities, equity, and financing, and use this information to develop strategies to reduce the risks posed by climate change and enhance their financial performance [31, 43].
2. Financial Reporting: The TCFD understands that reporting on climate-related financial impacts might not be in line with what's required by national financial reporting requirements. However, the TCFD encourages organizations to make financial disclosures in accordance with their national disclosure requirements. The TCFD has created a framework to assist public corporations and other organizations in disclosing climate-related risks and opportunities more effectively using their existing reporting systems [66].

The TCFD recommends that companies disclose the following information in their public annual financial reporting:

- The organization's governance revolves around climate-related risks and opportunities.

- The real and prospective consequences of climate-related risks and opportunities on the business, strategy, and financial planning of the firm.
- The organization's approach to identifying, assessing, and managing climate-related risks.

The TCFD recommendations are rapidly becoming the international norm for climate-based reporting. As a result, international standard setters are attempting to incorporate the recommendations into their disclosure standards in order to foster a more unified and comparable climate-related reporting approach globally. Additionally, standard-setting' organizations are all striving to create sustainability standards that are in line with the recommendations of the TCFD. This implies that companies and organizations can use these standards to communicate their climate-related threats and opportunities in a manner that is in line with global best practices [18, 64].

Here are some examples of international standard setters that are working to incorporate the TCFD recommendations into their own disclosure standards:

- IASB: International Accounting Standards Board.
- GRI: Global Reporting Initiative.
- SASB: Sustainability Accounting Standards Board.
- Risk Management: It is important for investors and other people to know how companies are dealing with the effects of climate change. That way, they can make the best decisions when it comes to investing and lending. The TCFD outlines how companies can share information about their climate risk management processes.

Here are some specific examples of the types of information that companies might disclose about their climate-related risk management processes:

- How they detect and evaluate climate-related hazards.
- The manner in which they incorporate climate-related risks into their existing risk management system.
- How they decide whether to reduce, transfer, accept, or regulate climate-related hazards.
- How they monitor and evaluate their processes for managing hazards associated with climate change.

Recent years have seen a surge in the demand for research into the disclosure of corporate climate change risk. Numerous studies have examined the effects of corporate climate change disclosure on financial performance, corporate financial reporting, and corporate risk management. Most results of these studies indicate corporate climate change disclosure has been found to enhance the quality of financial reporting and risk management practices.

Overall, further research is necessary to fully comprehend the implications of corporate disclosure on financial performance; the existing evidence suggests that disclosure can be a win–win for companies and their stakeholders.

Climate disclosure and financial performance

Abbas [1] suggests that environmental degradation is inversely related to financial instability. This implies that, when environmental degradation is increased, financial instability is also increased. This is due to the fact that companies are more inclined to invest in high-profit projects, even when they are not eco-friendly, during periods of financial uncertainty. This has an economic impact on all parties involved, from policymakers to environmentalists to financial analysts, who must collaborate in order to combat climate change and improve the standard of living for the population [1].

The direct and indirect effects of climate change risks on a company's financial performance may be significant. Direct effects may include a shift in production and operations, whereas indirect effects may include changes in assets, raw material suppliers, manufacturing processes, and support systems. Indirect impacts may include changes in operational and competitive environments, which may include environmental regulations, climate policies, the views of stakeholders, legal matters, and so on. Both direct and indirect impacts can have a financial impact on the firm's viability and performance [49]. For instance, when severe weather disrupts supply chains or when the rapid transition to a low-carbon economy necessitates new goods and services, causing an impairment of assets, the financial effects of climate change become increasingly apparent. Investments in innovation are considered to create new commercial prospects, such as new eco-friendly energy sources, electric vehicles, or processes that turn carbon dioxide in buildings into construction materials. The potential financial impact that climate change risk may have on investors' portfolios is becoming more and more apparent [51, 60].

With a more intricate weather and climate approximation, the relationship between climate change and the economy may be explored. By using the Palmer Drought Severity Index [51], for instance, it was discovered that a country's favorable exposure to droughts has a negative impact on the profitability of its firms [28].

Given that it can have both direct and indirect effects on a company's operations, the climate transition risk is

a little more appropriate to research how climate change would affect the long-term profitability of businesses [53].

Researchers are paying increasing attention to how the climate affects business profitability and performance. According to Berry and Rondinelli [7], businesses that practice environmental responsibility stand a chance of gaining the trust of their stakeholders, which might enhance their financial success. As a result of studies showing a substantial positive relationship between climate-related disclosures and company performance [4, 22, 33, 55], businesses all over the world have begun to go back to their earlier efforts to adopt sustainable practices.

Disclosures about climate change-related concerns are important, especially for determining the risks involved and forecasting future corporate performance, which in turn helps investors by indicating lucrative returns [36, 43]. Additionally, over time, a sustained shift in the environment transforms the firm's relatively beneficial geographic location [41]. As a result, business sector disclosures on climate change aid in accomplishing the twin goals of sustainability and profitability.

Ginglinger and Moreau [25] discover that greater climate risk results in lower leverage. They demonstrate that the reduction in leverage related to climate risk is shared between a demand effect and a supply effect. According to Addoum et al. [2], extreme weather conditions have a major negative influence on profits for over 40% of U.S. companies. They also show that these effects may be both beneficial and detrimental, causing harm to certain industries while benefiting others. Pankratz et al. [52] discover that an increase in exposure to extremely high temperatures has a detrimental effect on enterprises' operational income and revenues on a worldwide scale. Huang, Kerstein, and Wang [32] study a panel of 55 nations and show that climate risk at the national level is linked to poorer corporate profitability and increased earnings volatility. In their investigations of the effects of climate hazards on company performance, Huang et al. [32] and Kling et al. [38] discover that extreme weather occurrences are linked to lower and more unstable earnings and cash flows.

IFRS S2 states that it is reasonable to assume that climate-related risks and opportunities will have an impact on an entity's cash flows, ability to access capital, and cost of capital over the short, medium, and long-term [21].

Although the existing literature shows a positive correlation between climate change-related disclosures and business performance [10, 14, 42], the nature of this correlation is still unclear, as numerous studies have also found a negative or neutral correlation between the two variables [5, 61]. Wang et al. [60] support the uncertainty between climate change disclosure and corporate performance. The study by Freedman and Jaggi [23] disproved earlier research by reporting that the coefficients of their ROA failed to identify any meaningful connection with climate disclosure.

Users of general-purpose financial reports should be able to understand how an entity is performing in relation to its climate-related risks and opportunities, including progress toward any climate-related targets it has set and any other targets required to be met by regulation or law. This is accomplished by including climate-related financial disclosures on metrics and targets [12, 32]. An organization must reveal the following in order to fulfill its goal:

- Information pertinent to the categories of cross-industry metrics;
- Industry-based metrics linked to certain business models, activities, or other characteristics that are shared by participants in an industry; and
- The entity's goals for mitigating risks from climate change, adapting to those risks, and seizing opportunities presented by climate change, as well as any goals that are mandated by law or regulation. These goals should include metrics that the governance body or management will use to track progress toward these goals.

Governments and companies are becoming increasingly aware of the serious global challenges posed by climate change. However, the relationship between climate risks and financial performance is still relatively unknown [29]. Only a few studies have focused specifically on the financial impact of climate-related risks on the performance of listed companies around the world. While some cross-border research has been conducted on the impact of global climate change risk on business outcomes, there is still very little scientific evidence of the impact that climate risk can have on the performance of manufacturing enterprises [15, 27, 33, 50].

The first hypothesis can be developed in light of the discussion above:

H1 There is a significant positive relationship between climate risk disclosure and financial performance.

Climate disclosure and financial reporting

When climate-related risks are significant, organizations are required by accounting standards to report them in their financial accounts. Due to their increased exposure to climate-related hazards, several companies and industries are given greater prominence in financial statements. Climate-related hazards may have been taken into account by other organizations, but they might not have had a significant effect on the financial results.

Corporate reporting plays a crucial role in managing legitimacy by fostering transparency and lowering information asymmetry [44]. According to Deegan [16] and Dumay et al. [19], legitimacy theory has long been used to explain why businesses report on their social and environmental performance. Integrated accountability systems have been created as a result of the market, authorities, and public's rising focus on transparency, which shows how strategy, governance, operations, and financial and socio-environmental performance are interdependent [8].

According to the relevant financial reporting structure, management is in charge of creating the entity's financial statements. Management should think about whether and how climate-related issues could have a major impact on the financial statements when applying the financial reporting requirements, including the appropriateness of disclosures. Management is responsible for ensuring that estimates and judgments used in connection with climate-related issues in the financial statements are reasonable and have a rationale.

The possibility and effects of climate-related risks on the company should be evaluated by management. These factors will influence the organization's reaction and may have an impact on financial reporting, including significant disclosures [11, 35]. Whether the information is relevant is a factor to be taken into account when determining what information on climate-related risks and matters to report in the entity's financial statements.

The management should take the entity's climate-related strategies and obligations into account financially. When communicating with stakeholders outside of financial statements (such as through press releases, management comments, and sustainability reports), management should make sure all information is consistent with that which is disclosed in the financial statements [42].

Due to the increasing importance of climate-related financial information in economic decision-making, assurance has become more crucial than ever. Supervisory agencies increasingly incorporate financial statements connected to climate change into their yearly reviews and offer further guidance as appropriate.

Investors want to know more about how boards evaluate climate-related concerns, how relevant data has been incorporated into strategic planning, and how important decisions have been made.

In order to help the major consumers of general-purpose financial reports in their decision-making about the allocation of resources to the company, IFRS S2 requires an entity to publish information about its climate-related risks and opportunities [3, 21].

Investors also expect corporations to take into account and report on the impact on the financial statements, particularly on those components of financial statement reporting that require estimations of the future, if the impact is important to the business [18, 27]. These might, for instance, be:

- Assumptions of price and demand used in degradation test models related to carbon products;
- Depreciation rates of those assets whose economically useful lives may be affected by climate-related problems and any dismantling obligations that may arise therefrom;
- Recognition of a difficult contractual clause due to loss of income related to climate risk; and
- Other information not presented in the financial statements may influence investors' decisions.

Climate change can affect the financial statements of companies. Disclose key impacts and assumptions in financial statements; assets and liabilities must be valued and accounted for with climate change impacts in mind. Important assumptions regarding climate and associated uncertainties must be disclosed, even if no quantitative impact on the balance is recognized [17, 33].

The reasoning is that in order to make more informed financial decisions, investors, lenders, and insurers must understand how climate-related opportunities are anticipated to affect the organization's future financial position, as shown in the income statement, cash flow statement, and balance sheet [9].

Because of a lack of climate risk disclosure, the financial impacts of climate-related issues on organizations are not always clear or direct, and identifying the issues, assessing potential impacts, and ensuring material issues are reflected in financial records can be difficult for many organizations. **The primary reasons for this are likely to be (1)** a lack of knowledge of climate-related issues within organizations; **(2)** a tendency to focus primarily on near-term risks without paying adequate attention to longer-term risks; and **(3)** the challenge of determining the financial effects of climate-related issues.

The second hypothesis can be developed in light of the discussion above:

H2 There is a significant positive relationship between climate risk disclosure and financial reporting.

Climate disclosure and risk management

Nordhaus [50] classifies climate risk as a systematic risk. Businesses must incorporate climate risk assessment into their overall risk management procedures, and climate risk must be managed in the same way as

other risks that have the potential to significantly disrupt the company's business model.

Although the full consequences of climate change are unknown, the goal of climate-related financial disclosures on risk management is to help users of general-purpose financial reports understand an entity's processes for identifying, assessing, prioritizing, and monitoring climate-related risks and opportunities, including whether and how those processes are integrated into and inform the entity's overall risk management process. Indeed, climate change is seen as one of the most important sustainability risks that investors, in particular, need to be aware of and manage in their portfolio investments [39].

According to McKinsey & Company [42], the global socioeconomic implications of climate change might be enormous since climate change affects both human beings and physical and natural capital. The disclosure of climate risks and opportunities should allow a user to understand the risk or opportunity posed by climate change and the potential impact on the company. The disclosure should also enable a user to understand a firm's mitigating actions that the firm intends to take.

According to Clapp et al. [10], Climate risks are classified into six categories:

1. Climate-Related Physical Risks: Physical threats associated with climate change that necessitate adaptation include increasing sea levels, global temperature rise, and more frequent and extreme weather events. It is connected to extreme weather occurrences and the effects of those events. If the firm is immediately exposed to the unfavorable physical consequences of climate change, its capacity to function successfully will suffer. For example:
- Damage to private or public facilities.
- Loss of access to crucial business inputs.
- Market disruption.
- Decreased demand for essential products.
2. Climate-Related Transition Risks: Refers to the risks associated with moving towards a greener economy. It has to do with the transition to a low-carbon economy. Such transitions may involve changes in product structure, regulatory challenges, reputational issues, or higher operating costs. The social and political upheavals associated with these changes can also be generalized. It is tied to the characteristics of the transition to a low-carbon economy: technological changes, the introduction of policies, regulations and changes in production [7, 21].
3. Market and reputational risks: Corporations may be thought to be engaging in climate-damaging actions, thereby disrupting critical connections. Climate change has been cited as a possible source of reputational risk because of shifting consumer or community views of an organization's contribution to or detriment from the transition to a lower-carbon economy. For example [50, 61]:
- Reputational damage, resulting in serious consumer losses.
- Perceived risk or inadequate climatic adaptation may restrict capital supply or insurance coverage availability.
- Inability to satisfy environmental qualifying requirements for commercial customers.
- Increased societal demand for more regulation or taxation of essential economic operations.
- Competitors may take steps to decarbonize.
4. Policy, Legal, and Technology Risks: Climate-related legislation or regulation may have an influence on the firm or its consumers. For example [31, 45]:
- Additional carbon charges or taxes on company operations may be imposed.
- Additional carbon charges or taxes may be placed on suppliers' operations, or the cost or attractiveness of services provided by a business in the hands of a customer may be impacted.
- Increased possibility of climate-related litigation.
- Localized restrictions on the ability to operate certain sites may be imposed.
- The capacity to run the underlying business model may face widespread challenges.
- Restriction on critical business inputs or goods.
- Loss of demand owing to a reduction in consumer activity.
- The risks of new technology aimed at assisting the global carbon transition.
5. Technology Risks: Technological advancements or inventions that aid in the transition to a lower-carbon, energy-efficient economic system can have a substantial influence on enterprises [14].
6. Market Risks: The implications of climate change on markets are numerous and complex, but one of the most important is changes in the demand and supply of certain commodities, goods, and services as the risks and opportunities associated with climate change become increasingly apparent.

Physical, transitional, and other climate-related risks have a significant influence on the value of businesses and

their assets. Physical risks arise from the climatic impact of higher average temperatures (such as increased frequency and severity of weather-related events), whereas transition risks arise from changes in technology, markets, policy, regulation, and customer sentiment as a consequence of the transition to net zero [3, 19].

Climate change risk is influencing existing company plans, valuations, and investment decisions. Climate risks may be significant from the standpoint of a user, as follows [21, 46]:

1. Climate change risk implications are expected to be stated in the annual report; climate risk impacts on corporate governance, business model, corporate strategy, risk management, and performance, and prospects should be mentioned in the firm's annual report (where substantial).
2. Disclose climate change impacts and key assumptions in financial statements; assets and liabilities should be quantified and recorded with climate change in mind. Even if there are no quantitative consequences for recognized balances, important climatic assumptions and associated uncertainties should be communicated.
3. Climate disclosures in financial statements must be consistent with plans and strategies described in the front end of the firm's annual report (where relevant and important to a user's).

The third hypothesis can be developed in light of the discussion above:

H3 There is a significant positive relationship between climate risk disclosure and risk management.

Research methodology

Building on previous research that has examined the types of climate risk information disclosed by companies and the factors that influence the amount of disclosure, this study aims to investigate the financial impact of climate risk disclosure and how financial reports should disclose this impact. The research also highlights the importance of linking corporate strategies to climate change mitigation.

The research methodology aims to: investigate the financial impact of climate risk disclosure; determine how financial reports should disclose the financial impact of climate risk; and highlight the importance of linking corporate strategies to climate change mitigation.

This research is based on previous studies that have developed methods for measuring disclosure levels. This information can be used to create statistical models that can be used to predict or analyze disclosure levels.

Research variables and models

Climate-related risks are a constant threat to the survival and growth of business organizations. As a result of climate-related risks, companies are working to build and develop tools to measure, understand, and analyze climate-related impacts on firm profitability, the quality of financial reporting to comply with the full disclosure principle as required by GAAP, and how CRM can mitigate them.

This research aims to address a gap in the literature by investigating how corporate climate change disclosure affects the operations and performance of businesses. Climate change is a systemic risk facing businesses, and its impacts on businesses are complex and not fully understood. By better understanding how climate change disclosure affects businesses, this study can help businesses better manage their climate-related risks and opportunities.

The purpose of this research is to

1. Present and evaluate the impact of climate change risk disclosure on company performance.
2. Present and evaluate how climate change risk disclosure impacts financial reporting research, and
3. Evaluate how risk management is impacting climate change risk disclosure practices in Egypt.

As shown in Fig. 2, this research defined the relationship between variables as the following three models:

Model (1): The relationship between climate risk disclosure and financial performance.

Return on Assets $= \alpha + \beta_1$ Climate Risk Disclosure $+ \beta_2$ Firm Size $+ \beta_3$ Tobin's Q + e.

Model (2): The relationship between climate risk disclosure and financial reporting.

Climate Financial Reporting Impact $= \alpha + \beta_1$ Climate Risk Disclosure $+ \beta_2$ Firm Size $+ \beta_3$ Tobin's Q + e.

Model (3): The relationship between risk management and climate risk disclosure.

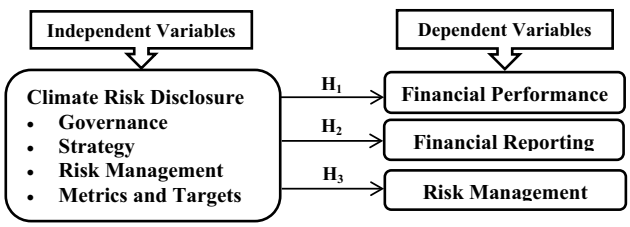

Fig. 2 The impact of climate disclosure on financial performance, financial reporting and risk management

Table 1 Research variables: type and measures

Variables	The type of the measure	Measurements
Independent variables		
Financial performance	Financial ratio	The return on assets of a company is computed by dividing the net income it generates by the average of total assets
Financial reporting	Index	FR_j = Σ Actual Score / Σ Maximum Score points Dummy variable with values 0 and 1
Risk management	Index	RM_j =Σ Actual Score / Σ Maximum Score points Dummy variable with values 0 and 1
Dependent variable		
Climate risk disclosure	Index	CRD_j = Σ Actual Score / Σ Maximum Score points Dummy variable with values 0 and 1
Control variables		
Firm size	Numeric value	Firm size is calculated using the natural logarithm of the total book value of the company's assets
Firm value	Tobin's Q	Tobin's Q ratio is calculated by dividing a company's total market value by the total value of its assets

Climate Risk Management = $\alpha + \beta_1$ Climate Risk Disclosure + β_2 Firm Size + β_3 Tobin's Q + e.

Sample selection

The sample for this research was drawn from the Egyptian stock exchange market. The investigation began with a search for organizations that suggested that they're familiar with the notion of climate risk management. Firms were first identified as adopting the CRM concept based on a search of the following key terms: strategic risk management, risk management, risk committee, risk management committee, and chief risk officer. 25 manufacturing companies were selected, and their financial statements from 2019 to 2022 have been sorted and obtained from https://www.mubasher.info/markets/EGX.

While climate change has the potential to affect all businesses, particular entities or industries may be more vulnerable to the risks associated with climate change due to their location, operations, business models, or rules and regulations. The research was conducted based on secondary data on publicly traded companies in the industries most affected by climate change, as follows:

1. Food, beverages, and tobacco
2. Industrial goods, services, and automobiles
3. Energy and support services
4. Textile and durables
5. Shipping and transportation services; and
6. Building materials

Table 1 presents the variables employed by the research and its measurements. The variables include three types: dependent variable (climate risk disclosure), independent variables (financial performance, financial reporting, and risk management), and control variables (firm size and firm value) that have an impact on the dependent and independent variables.

Climate-related risks disclosure index

Disclosure indices are detailed lists of specific issues that may be mentioned in corporate reports. In accounting research, calculating an index score for a given firm has been used to offer an indication of the extent of disclosure while not certainly the quality of disclosure.

In this research, the main independent variable is a climate-related risk. CRD is measured using a checklist of 10 recommended disclosures divided into 4 categories: CRD = f (Governance, Strategy, Risk Management, Metrics and Targets).

A checklist is reviewed using content analysis and a dummy variable approach: each suggested disclosure item is assigned a value of 1 if it is disclosed and 0 if it is not disclosed.

Table 2 presents the climate-related risk disclosure index. First, for all companies, the total value of each item is added together to produce the climate-related risk disclosure index for each item individually, using the following formula:

$$\mathrm{CRD}_j = \sum X_j / N$$

$$0 \leq \mathrm{CRD} \leq 1 (\text{maximum} \sum X = 25)$$

where, N_j = 25, the number of companies j used in the sample. X_{ij} Content analysis; climate risk disclosure is measured by the dummy variable. If the item is disclosed, the value is 1; otherwise, the value is 0. CRD_j Climate related risk disclosure index for each of the four categories.

Table 2 Climate-Related Risks Disclosure Index

Category	*CRD = f (Governance, Strategy, Risk Management, Metrics and Targets)*	Binary Variable	
	Recommended Disclosures	**0 = not disclosed**	**1 = disclosed**
Governance	1. Describe the board's control over climate-related opportunities and risks 2. Describe management's role in identifying and resolving climate-related opportunities and threats		
Strategy	3. Describe how the organization has identified short-term, medium-term, or long-term risks and opportunities associated with climate change 4. Describe the impact of climate-related risks and opportunities on the organization's operations, strategy and financial planning 5. Describe the organization's strategic resilience when considering different climate-related scenarios, such as a 2 °C or lower scenario		
Risk management	6. Describe the company's procedures for determining and evaluating climate-related risks 7. Describe the organization's procedures for handling risks associated with the climate 8. Describe how the organization's overall risk management is incorporated into the processes for identifying, evaluating, and managing climate-related risks		
Metrics and targets	9. Describe the metrics the organization employs to evaluate climate-related risks and opportunities in accordance with its strategy and risk management approach 10. Describe the organization's objectives, how they are being met, and the potential risks and opportunities associated with climate change		

N Total items for each category as follows: (1) Governance ($x=2$); (2) Strategy ($x=3$); (3) Risk management ($x=3$); and (4) Metrics and targets ($x=2$).

Then, a disclosure index was calculated for each of the four categories as the ratio of the actual score of all firms in each category divided by the overall score of the category.

$$0 \leq \text{CRD} \leq 1(\text{maximum} \sum X = 10)$$

Climate financial reporting impact index

The climate risk-financial reporting impact index is shown in Table 3. This checklist covers key financial accounting and disclosure issues that analysts should evaluate with regard to the financial consequences of the climate's impact on a company, including both physical and transition-related risks and opportunities.

First, for all companies, the total value of each item is added together to produce the climate-related risk disclosure index for each item individually, using the following formula:

$$\text{FR}_j = \sum X_j / N0 \leq \text{FR} \leq 1(\text{maximum} \sum X = 25)$$

where, $N_j=25$, the number of companies j used in the sample.

X_{ij} Content analysis; climate risk-financial reporting impact is measured by the dummy variable. If the item is disclosed, the value is 1; otherwise, the value is 0. FR_{ij} Financial reporting impact index for each of the 12 categories.

X Total items for each category, as follows: (1) Presentation of financial statements ($X=4$); (2) Estimation uncertainties and assumptions ($X=1$); (3) Fair value measurement ($X=2$); (4) Financial instruments ($X=2$); (5) Liquidity ($X=1$); (6) Impairment of assets ($X=1$); (7) Cash flow ($X=1$); (8) Intangible assets (X = 1); (9) Inventories ($X=1$); (10) Property, plant, and equipment ($X=2$); (11) Provisions and contingent liabilities ($X=3$); and (12) Revenue ($X=2$).

Then, a disclosure index was calculated for each of the 12 categories as the ratio of the actual score of all firms in each category divided by the overall score of the category.

$$0 \leq \text{FR} \leq 1(\text{maximum} \sum X = 21)$$

Climate risk management index

Table 4 presents the climate risk management index. For all sample companies, the total value of each risk category from the six categories is added together to produce the CRM index for each item individually, using the following formula:

$$\text{CRM}_j = \sum X_j / N0 \leq CRM \leq 1(\text{maximum} \sum X = 25)$$

where, $N_j=25$, the number of companies j used in the sample. X_{ij} Content analysis; climate risk-financial reporting impact is measured by the dummy variable. If the item is disclosed, the value is 1; otherwise, the value is 0. $X=$ Total items for each category as follows: (1) *Credit Risk*; (2) *Liquidity risk;* (3) *Other financial risk*; (4) *Operational risk*; (5) *Legal/compliance risk*; and (6) *Other non-financial risk.*

Table 3 Climate financial reporting impact index

Category	***FR = f (Presentation of financial statements, Estimation uncertainties and assumptions, Fair value measurement, Financial instruments, Liquidity, Impairment of Assets, Cash Flow, Intangible assets, Inventories, Property, plant and equipment, Provisions and contingent liabilities, Revenue)***	**Binary Variable**	
	Recommended Impacts	**0 = not disclosed**	**1 = disclosed**
Financial statements presentation	1. Is management aware of significant climate-related uncertainties that could make it questionable whether the entity can continue as a going concern? Have these been made public, if so? 2. If the IFRS requirements are insufficient to allow users to comprehend the effects of significant climate-related matters on the entity's financial position, financial performance, and cash flows, have additional disclosures been made? 3. Are there any climate-related details that are relevant to understanding the financial statements but are not included in the statements of financial position or profit or loss but are disclosed in the notes to the financial statements? 4. Is it possible to improve the quality and accessibility of quantitative climate-related financial disclosures in order to ensure consistency between financial statements and climate-related financial disclosures?		
Estimation uncertainties and assumptions	5. Have the significant risk factors for a material adjustment to the carrying amounts of assets and liabilities within the upcoming financial year, including key future assumptions and other significant sources of key estimation uncertainty, been disclosed?		
Fair value measurement	6. Does disclosing how climate-related risks are taken into account in any fair value calculations aid users in evaluating the valuation methods and inputs—including those related to climate change—used to determine the assets and liabilities fair values? 7. Has the appropriate disclosure been made in cases where climate-related inputs into determining the fair value of assets and liabilities are thought to be a significant source of estimation uncertainty?		
Financial instruments	8. Disclosure is provided regarding how exposure to climate-related risk affects projected credit losses for loans and investments? 9. Disclosure is provided about how the entity controls its exposure to climate-related risks with respect to financial instruments?		
Liquidity	10. Has the management of material liquidity risks related to climate change been disclosed?		
Impairment of assets	11. Has the entity considered whether there are any indicators of asset impairment related to the climate?		
cash flow	12. Has the influence of identified climate-related indicators on long-term future cash flows, asset remaining usable lifetimes, and value in use calculation when determining the recoverable amount of the assets in issue been assessed?		
Intangible assets	13. Have the effects of climate-related issues been taken into account when determining the amortization period and method for intangible assets with a limited useful life by the entity?		
Inventories	14. Have such costs been excluded from inventory balances and expensed as incurred where climate-related events have caused interruptions in the production or development of inventories, while costs that do not necessarily contribute to bringing the inventories to their current location and condition and are considered "abnormal"?		
Property, plant and equipment	15. Has the company considered how climate-related factors may have affected the remaining value and useful life of its assets? 16. Have the sources of estimation uncertainty and important assumptions, as well as relevant sensitivities, been reported when substantial climate-related assumptions or estimates have been utilized in determining the usable life and/or residual value of the asset?		

Table 3 (continued)

Category	*FR = f (Presentation of financial statements, Estimation uncertainties and assumptions, Fair value measurement, Financial instruments, Liquidity, Impairment of Assets, Cash Flow, Intangible assets, Inventories, Property, plant and equipment, Provisions and contingent liabilities, Revenue)*	Binary Variable	
	Recommended Impacts	**0 = not disclosed**	**1 = disclosed**
Provisions and contingent liabilities	17. Have any disclosures been made about climate-related uncertainty concerning the timing of the repayments of the obligations for which the company has provided? 18. Where the effect of the time value of money is considerable, has the entity addressed the risks and uncertainties associated with climate-related problems when estimating the cash flows and discount rates to measure its provision? 19. Has the entity considered whether it might be necessary to disclose new contingent liabilities related to climate-related issues for potential obligations or for previously remote contingencies that now seem likely?		
Revenue	20. Has the company taken into account how climate-related factors may affect the amount of money it makes or spends to complete contracts that span several months/years? 21. Has the company provide extra information where significant judgment has been required in assessing the impact of climate-related factors on contracts that span several months/years, and/or the term of amortization of capitalized contract costs?		

Table 4 Climate risk management index

Category	*CRM = f (Credit Risk, Liquidity Risk, Other Financial Risk, Operational Risk, Legal/Compliance Risk, Other Non-financial Risk)*	Binary Variable	
	Recommended Impacts	**0 = not disclosed**	**1 = disclosed**
Credit risk	Climate-related financial risks should be considered by management, including credit risk concentrations resulting from physical and transition risks might be part of effective credit risk management techniques. Management should evaluate potential changes in correlations across exposures or asset classes as part of the concentration risk assessment. Management should define credit risk tolerances and lending restrictions connected to these risks in accordance with the company's tolerance for risk		
Liquidity risk	Management should analyze if climate-related financial risks might influence its liquidity position and, if so, include such risks into their liquidity risk management methods and liquidity buffers in accordance with sound oversight and liquidity risk management		
Other financial risk	Management should keep a focus on interest rate risk and other model inputs for signs of increased volatility or less predictability as a result of climate-related financial concerns. Management should add commensurate levels of conservatism to their risk measurements and controls when applicable. Management should pay attention to how climate-related financial risks influence the company's exposure to pricing risk		
Operational risk	Management should think about how financial risk exposures related to climate change might negatively affect the operations, regulatory environment, and operational resilience of the company		
Legal/compliance risk	The management of the company should take into account how the legal and regulatory environment in which it operates is affected by financial risks related to climate change and risk mitigation measures		
Other non-financial risk	The board and management should monitor how the operating environment and the implementation of strategic decisions impact the company's operational resilience and financial condition in accordance with sound oversight, as discussed in the strategic planning section		

Data analysis and discussion of results

Descriptive statistics

Table 5 presents univariate descriptive statistics for overall climate-related financial disclosure as well as the four fundamental parts of climate change as proposed by the TCFD [57]. A review of the table indicates that some companies do not provide any climate change-related financial disclosures, as required by the TCFD.

Table 5 Descriptive statistics

Variables	*N*	Minimum	Maximum	Mean	Std. deviation
Climate risk disclosure (CRD)	100	0.00	1.00	0.4750	0.4875
Return on assets (ROA)	100	1.658	0.365	0.0587	0.2587
Climate financial reporting (FR)	100	0.00	1.00	0.3256	0.1257
Climate risk management (CRM)	100	0.00	1.00	0.6548	0.4879
Firm size (FS)	100	3.126	6.778	5.158	0.6143
Tobin's Q (TQ)	100	0.545	10.789	1.587	1.587
Valid *N* (listwise)	100				

Table 6 Regression results

Model	Unstandardized Coefficient B	Drisc/Kraay Standard errors	P – value	Decision
Panel (A): The impact of ROA on CRD				
(constant)	3.756	0.658	0.000	
Climate risk disclosure	3.203	1.198	0.011	Significant
Firm Size	0.086	0.092	0.358	Insignificant
Tobin's Q	3.254	1.002	0.003	Significant
Panel (B): The impact of FR on CRD				
(constant)	3.489	0.458	0.000	
Climate Risk Disclosure	1.671	1.968	0.042	Significant
Firm size	0.072	0.077	0.360	Insignificant
Tobin's Q	2.138	1.127	0.066	Significant
Panel (C): The impact of RM on CRD				
(constant)	3.158	0.758	0.000	
Climate risk disclosure	0.838	0.576	0.015	Significant
Firm size	0.031	0.026	0.245	Insignificant
Tobin's Q	0.044	0.205	0.831	Insignificant

Table 6 displayed the results of Panels (A), (B) and (C) as follows:

- **Panel (A)** shows the results of panel regression for model 1 estimated using pooled OLS, with return on assets being the dependent variable and climate risk disclosure being the independent variable.
- **Panel (B)** shows the results of panel regression for model 2 estimated using pooled OLS, with climate disclosure-financial reporting impact being the dependent variable, while climate risk disclosure is the independent variable.
- **Panel (C)** shows the results of panel regression for model 3 estimated using pooled OLS, with climate disclosure-risk management being the dependent variable and climate risk disclosure being the independent variable.

For Panel (A), the results displayed in Table 6 show that the climate risk disclosure variable has a significant impact on firm profitability at the 1% level of significance. The findings indicated that Return on Investment (ROA) has a significant effect on climate risk disclosure, indicating that in order to achieve financial success; a company must strive to reduce waste in its benefit service processes and systems. The extent to which a company meets its objectives and mission is the primary measure of success, with efficiency being the maximization of output, effectiveness being the achievement of all desired results, and economy being the cost minimization [34]. This result was supported by many studies in the literature, such as [4, 18, 25, 45, 60]. Moreover, for control variables, findings showed that firm size has a positive impact on firm profitability, which indicates that large firms were more profitable than smaller ones. This result was supported by many studies in the literature, such as [7, 13, 19, 24]. Also, firm value showed a significant positive impact on firm profitability. This implies that firm value, measured by Tobin's Q, does play a significant role in determining a firm's financial position.

Model (1): The relationship between climate risk disclosure and financial performance.

Return on Assets = 3.756 + 3.203 Climate Risk Disclosure + 0.086 Firm Size + 3.254 Tobin's Q + e

For Panel (B), the results displayed on Table 6 show that climate risk disclosure variable has a significant impact on financial reporting at the 1% level of significance. The findings revealed that climate risk disclosure positively impact financial reporting, and in turn, this affects interested decision-makers. This result was supported by many studies in the literature, such as [16, 23, 43, 50]. Moreover, for control variables, findings showed that firm size has an insignificant positive impact on financial reporting which indicates that large firms are more dedicated and conform with GAAP and are more interested in voluntary and non-voluntary disclosures than smaller ones. This result was supported by many studies in the literature such as [18, 30, 41, 54]. Also, firm value showed a significant positive impact on financial reporting. This implies that firm value, measured by Tobin's Q, does play a significant role in determining a firm's financial reporting.

Model (2): The relationship between climate risk disclosure and financial reporting.

Climate Disclosure Financial Reporting Impact = 3.489 + 1.671 Climate Risk Disclosure + 0.072 Firm Size + 2.138 Tobin's Q + e

For Panel (C), the results displayed in Table 6 show that climate risk disclosure variable has a significant impact on how the firm manages climate risk at the 1% level of significance. The findings revealed that climate risk disclosure impact positively risk management. This result was supported by many studies in the literature, such as [11, 22, 49]. Moreover, for control variables, findings showed that both firm size and firm value have a positive but insignificant impact on CRM, which indicates that large and high valued firms are more interested in climate change risks and findings ways how to deal with and manage this risk.

Model (3): The relationship between risk management and climate risk disclosure.

Climate Risk Management = 3.158 + 0.838 Climate Risk Disclosure + 0.031 Firm Size + 0.044 Tobin's Q + e

Climate risk disclosure impact on financial reporting

Currently, most climate-related data is published outside of financial reporting. However, as climate-based risks increasingly weigh on financial reporting and investors' attention, more climate-based information is expected to be incorporated into financial reporting.

According to the results in Fig. 4, companies whose core operations rely on natural conditions will suffer physical asset losses, increased costs, business disruptions, and reduced operating income, all of which will have a negative impact on the company's financial performance. Climate change has the potential to disrupt manufacturing processes and significantly reduce revenues [28, 33]. The supply chain encompasses the activities required to get a product from conception to distribution for organizations that make goods, such as raw material acquisition, manufacturing operations, and product marketing. Climate change will have an impact on the supply of raw resources for manufacturing. These changes have an immediate impact on suppliers, employees, and market demand throughout the company's supply chain. Thus, in the long run, climate change will limit corporate production capacity, alter the capital structure, increase expenses, and decrease business profitability. Companies must also modify their business models to address the threats posed by climate change [31, 48].

Income statement

Revenues: Transitions and physical risk can impact demand for products and services. Organizations should consider the potential impact on revenue and explore potential options to improve or expand revenue.

Expenditures: The cost structure of a business may influence how it responds to climate-related risks and opportunities. Lower-cost suppliers may be more robust to cost fluctuations caused by climate-related difficulties and more adaptable in their capacity to resolve such challenges. Organizations may better inform investors about their investment possibilities by indicating their cost structure and ability to adjust. It also helps investors understand capital expenditure plans and the amount of debt or equity required to support these plans. The resilience of such plans should be evaluated in light of organizations' ability to transfer funds and capital markets' willingness to support organizations exposed to large levels of climate-related risk. Transparency in these strategies may provide for easier access to capital markets or better financing arrangements.

Balance sheet

Assets and Liabilities: Changes in supply and demand as a result of legislative, technological, and commercial factors related to climate change may have an influence on the value of an organization's assets and liabilities. Climate-related challenges may have a disproportionately unfavorable influence on the usage of long-lived assets and, where relevant, reserves. Organizations must provide a prediction of the potential impact of climate change on their assets and liabilities, particularly

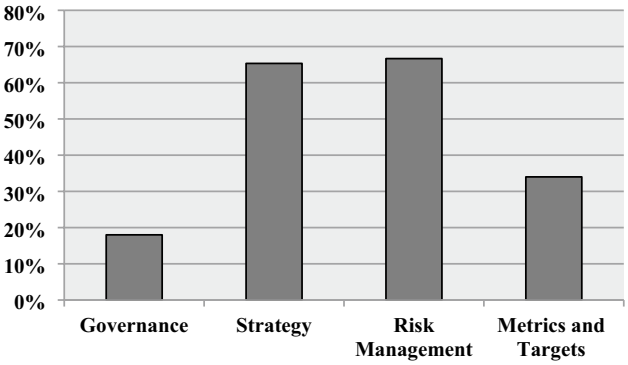

Fig. 3 Climate-related risks disclosure index as recommended by the TCFD

long-lived assets. This should be focused on existing and committed future activities, as well as measures requiring further investment, restructuring, write-downs, or impairments.

Capital and Financing: Climate-related risks and opportunities may alter the profile of an organization's debt and equity structure, either by raising debt levels to compensate for decreasing operational cash flows or for increased capital expenditures or R&D. It may also impair the organization's capacity to obtain new debt, refinance current debt, or lower the tenure of borrowing available. Changes in capital and reserves might also result from operational losses, asset write-downs, or the need to issue stocks in order to cover an investment [15, 35].

Figure 3 presents the climate-related risk disclosure index as recommended by the TCFD. This is true for the overall disclosure score and further extends to all four core elements, as shown in Fig. 4. It is evident from Figs. 3 and 4 that the sample firms disclose in the published reports more strategy-related items, followed by risk management. Metrics and targets, and governance, however, have low observed scores.

- **Strategy:** Investors and other stakeholders must understand how climate-related challenges may influence a company's operations, strategy, and financial planning in the short, medium, and long term. This information is utilized to establish expectations about an organization's future performance.
- **Risk Management:** Investors and other stakeholders must understand how climate-related risks are recognized, analyzed, and managed in a firm, as well as if such procedures are incorporated into current risk management systems. Users of climate-related financial disclosures can use this information to assess the organization's overall risk profile and risk management measures.
- **Metrics and Targets:** Investors and other stakeholders must understand how a company assesses and manages its climate-related risks and opportunities. Investors and other stakeholders can better assess an organization's potential risk-adjusted returns, ability to meet financial obligations, general exposure to climate-related issues, and progress in managing or adapting to those issues with access to its metrics and targets. This also serves as a foundation for investors and other stakeholders to compare firms within the same sector or industry.
- **Governance:** Investors and other stakeholders are interested in knowing how an organization's board oversees climate-related issues, as well as how management evaluates and manages those issues. These stakeholders include investors, lenders, insurance underwriters, and other users of climate-related financial disclosures. Such data aids assessments of whether board and management attention is given appropriately to climate-related issues.

Accounting for climate change is the practice of including potential financial risks and opportunities related to climate change in financial reporting. Examining the financial effects of climate-related issues is part of this. Figure 5 illustrates the empirical findings regarding the impact of climate-related risk on financial and non-financial reporting as follows:

- Climate-related issues could have an impact on how assets and liabilities in the financial statements are measured at fair value. For instance, the opinions of market participants regarding potential climate-related legislation may have an impact on the fair value of an asset or liability.
- A company may alter its spending or adapt its business operations, including research and development, in response to climate-related issues.
- Climate-related issues may signal a change in the estimated residual value and anticipated useful lives of assets, for instance, due to obsolescence, statutory limitations, or the inaccessibility of the assets. Companies must also disclose the nature and extent of any change in estimated residual values or expected useful lives, as well as the expected useful lives for each class of asset.
- Climate-related factors may have an impact on how provisions and contingent liabilities are recognized, measured, and disclosed in the financial statements of the company.

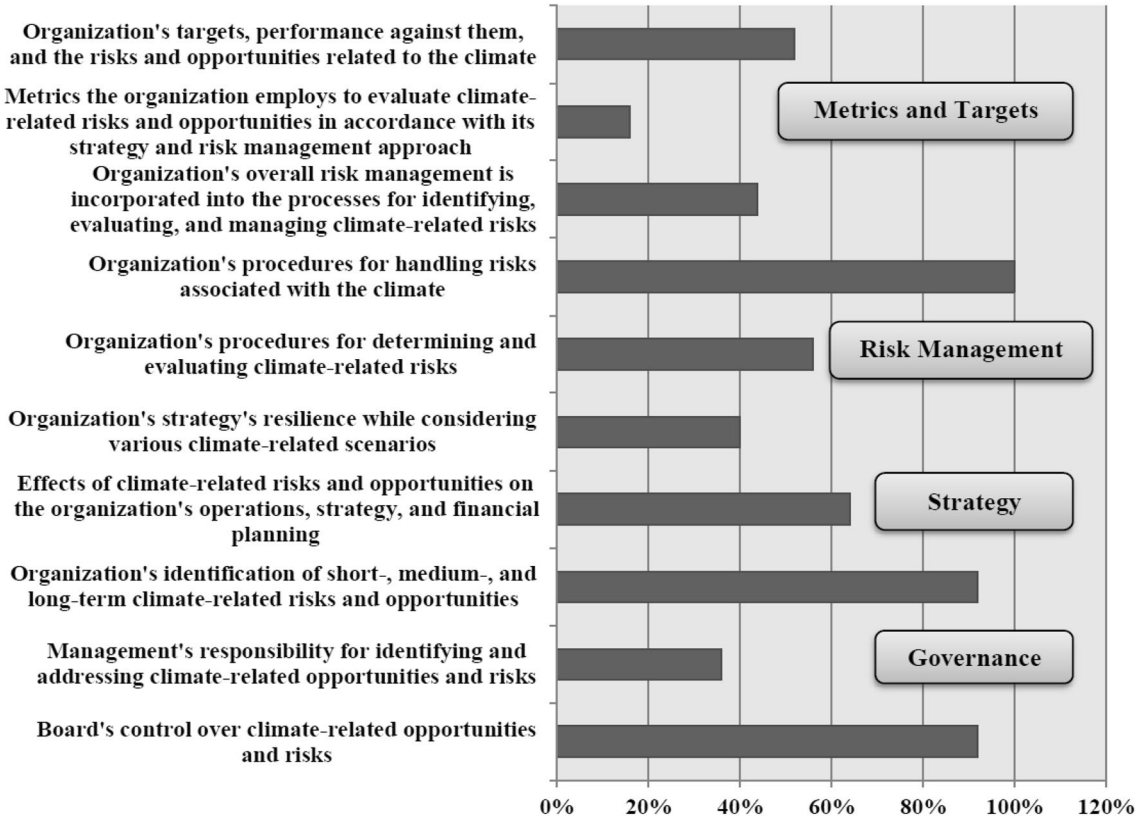

Fig. 4 Recommended TCFD four core elements (governance, strategy, risk management, and metrics and targets)

- Climate-related factors could make a company's inventories obsolete, its selling prices drop, or its completion costs rise.
- Climate-related issues may result in signs that a particular asset (or a collection of assets) is impaired.
- Climate-related issues may have an impact on how a company estimates its future taxable profits and may prevent it from recognizing deferred tax assets or force it to derecognize assets that it has already recognized.

Investors, other users, policymakers, preparers, standards setters, regulators, and auditors have all become more concerned in recent years about the effects of climate change on financial reporting. According to some, the proper operation of the capital markets depends on increased transparency regarding the impacts of climate change on the financial position and performance of entities. By providing investors with full disclosure, investors will be better able to assess future expected cash flows [4, 18].

Others contend that greater transparency should be seen less as an end in itself than as a means of influencing how entities behave. According to this theory, requiring management to disclose the impact of climate change on future cash flows as well as the steps taken to mitigate its negative effects and promote its positive effects will influence management focus and the allocation of human, financial, and other resources [20]. This increased focus on the financial statements' impact of climate change is occurring against the backdrop of a broader understanding of the significance of sustainability reporting, which goes beyond just covering risks related to the climate.

Many initiatives to standardize sustainability disclosures (including those related to climate change) have been launched in response to the need for greater transparency. These initiatives range from national and international non-mandatory standards, metrics, and targets suggested by business associations to mandatory disclosure requirements [18, 26].

We believe that Egyptian companies will soon be required to disclose information about the likely impact of climate change on their businesses, both financially and strategically. This information will be important for investors and other stakeholders to understand the risks and opportunities companies face and how they plan to manage them.

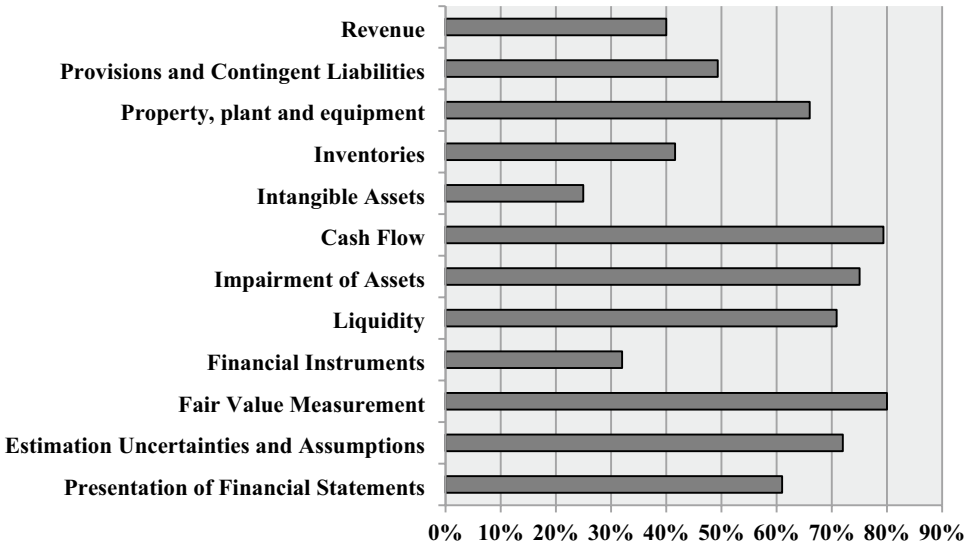

Fig. 5 Climate risk disclosure impact on financial reporting

Integrated financial reporting is a type of financial reporting that combines financial and non-financial information into a single report. This type of reporting is becoming increasingly popular because it allows investors and other stakeholders to get a more complete picture of a company's performance.

Here are some specific examples of the types of information that we might expect to see in integrated financial reports on climate change

- Information about the company's exposure to climate-related risks and opportunities, such as the physical risks of climate change (e.g., flooding, droughts, and extreme weather events), and the transition risks associated with moving to a low-carbon economy.
- Information about the company's financial strategy for managing climate-related risks and opportunities, such as how it plans to invest in new technologies or reduce its carbon emissions.
- Information about the company's risk management processes for climate change, such as how it identifies, assesses, and mitigates climate-related risks.

Integrated financial reports should include this type of data in order to enhance the resilience of the financial system to the effects of climate change as well as to encourage more environmentally responsible investment and lending practices.

Figure 6 shows the CRM index; the findings show that investors are interested in knowing how risks have been identified, as well as which risks have been found and their relative importance, as well as what the company plans to do about them. To determine how resilient a company is to risk and how well-positioned it is to respond, they are using the risk disclosures.

The risk management approach necessitates qualitative disclosure. In addition, if available, investors want quantitative information on how firms are affected on an asset-by-asset basis. Financial data is vital in analyzing potential consequences for future cash flows, and organizations must also examine the impact on their financial statements. Investors appreciate the data's problems, such as quality and timeliness, but urge firms to provide more relevant data [32, 49].

This research has found similar results to previous studies on climate change disclosure. For example, the study by De Aguiar and Bebbington (2014) found that companies are increasingly disclosing information about climate change in their annual reports [15]. The study by Nikolaou et al. [48] found that climate change and climate risks can have a significant impact on a company's financial performance and operational processes [48].

The findings of this research are supported by Labatt and White [41] study, which showed climate change is a serious risk for businesses, and investors want to know how businesses are managing this risk. Businesses that do not manage their climate-related risks effectively could see a negative impact on their financial performance and overall value [40].

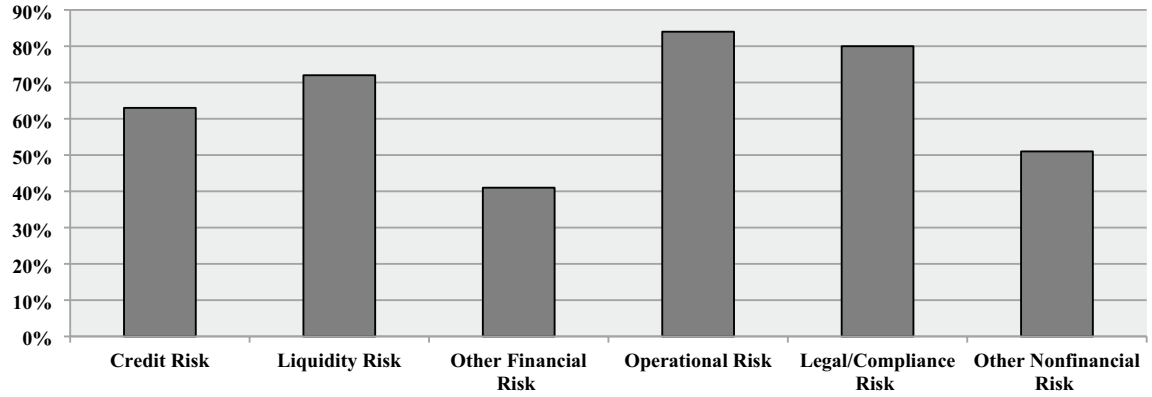

Fig. 6 Climate risk management index

According to the Global Investor Coalition on Climate Change [26], investors are increasingly demanding information about how climate change is impacting businesses, and businesses that disclose this information are more likely to attract investors and raise capital [26].

Here are some specific examples of the ways that climate change can impact businesses

- More extreme weather events, such as floods, droughts, and wildfires, can damage or destroy business assets, disrupt operations, and increase costs.
- Changes in consumer demand, such as a shift towards more sustainable products and services, can impact business revenue.
- New regulatory requirements, such as carbon taxes or emissions caps, can increase business costs.

Businesses can manage their climate-related risks by:

- Investing in renewable energy and other low-carbon technologies to reduce their carbon footprint and make their operations more resilient to climate change.
- Developing strategies to adapt to the impacts of climate change, such as developing new products and services that meet the needs of consumers in a changing climate.
- Disclosing information about their climate-related risks to investors and other stakeholders.

By taking these steps, businesses can reduce their exposure to climate-related risks and improve their financial performance.

Most expectations for risk management assume that businesses will incorporate climate risk into ongoing risk management processes rather than as a separate procedure or factor.

Climate change is a complex issue with a wide range of financial impacts on organizations. It can be difficult for organizations to identify, assess, and report on these impacts, but such impacts are important for investors, lenders, and insurance underwriters who need this transparent information to make informed financial decisions about their investments and lending practices. They need to understand how climate change is likely to affect the financial performance and position of the organizations they invest in or lend to.

Companies need to take climate change more seriously. They must develop plans to reduce greenhouse gas emissions and adapt to the impacts of climate change. They also need to be more transparent about climate-related risks and opportunities. By improving the quality of climate-related financial information, organizations can help promote transparency and market efficiency.

Here are some particular actions that businesses may take:

- Establish aggressive goals for reducing greenhouse gas emissions.
- Invest in renewable energy and other low-carbon technologies.
- Improve energy efficiency and reduce waste.
- Develop climate adaptation plans to protect their assets and operations from the impacts of climate change.
- Disclose their climate-related risks and opportunities in a clear and comprehensive way.

By taking these actions, companies can help reduce the risks of climate change and build a more sustainable future for all.

Conclusion

Today, policymakers and the general public are paying close attention to climate change. Over the past few years, expectations for reporting on climate-related issues have increased, particularly those of investors and other stakeholders. Less research has been done on the type of impact that disclosure of climate-related risks is having on financial performance and financial statements. In this research, the relationship between the firms' financial performance, financial reporting, and risk management in the context of Egypt was examined.

For increased reliability, the research employs the methodology of content analysis on the annual reports and/or sustainability reports of the companies that are extracted from their respective websites. As a proxy for the sample firms' financial performance, ROA is used.

The results show that, in comparison to companies with low climate risk disclosure scores, ROA will be higher for companies with higher climate risk disclosure scores. As a result of the regression analysis, it was also discovered that the market views the voluntary disclosure of climate change as a commendable corporate initiative, as indicated by a strong positive regression coefficient.

Overall, the findings show that not all climate-related information that is necessary to comprehend the entity's financial position and financial performance is reflected in financial statements. Financial statement preparers are required to disclose information on any climate-related issues that are deemed important in order to increase the financial statements' relevance.

The research aimed to assess whether the non-financial sector in Egypt is equipped to manage climate risks and disclose climate-related financial risks. The findings revealed that many companies in Egypt are not reporting on climate risks or providing meaningful commentary about the challenges they face. The majority of companies surveyed are not conducting scenario analysis or disclosing the results. Only a small percentage of companies surveyed are referencing climate-related matters in their financial statements, both qualitatively and quantitatively.

The results demonstrate that the majority of Egyptian companies are not adequately prepared to address climate-related risks or provide information on financial climate-related risks. This is concerning, as climate change poses a significant financial risk to businesses. Companies must take climate change seriously and develop strategies to mitigate their climate-related risks.

The results show that the TCFD's core elements of climate change disclosure as well as the overall disclosure of climate-related risks, have a significant positive impact on firm performance and financial reporting. In order to assess climate-related risks in their decision-making, managers, investors, policymakers, and other stakeholders must consider the economic ramifications of voluntary environmental disclosures by businesses operating in developing economies like Egypt.

Companies and society are being affected by climate change. Companies are dealing with the consequences of climate change, and one of the main reasons is that investors want action. Investors want to see how a company is dealing with the impact of climate change on their business, risk management, and financial performance. They want to know what issues the company faces in the future and how the company plans to tackle them. Companies are offering narrative reporting on climate-related issues in greater numbers. Investors are requesting more information so they can make informed decisions where the bare minimum of legal requirements is being met. Although some businesses have set strategic objectives like becoming "net zero" (or carbon neutral), it is frequently difficult to tell from their reporting how these objectives will be met, tracked, or ensured. Both the potential impact on a company's future and the company's impact on the environment are covered by the requirements and expectations for climate-related narrative reporting.

The responsibility for ensuring that financial statements adhere to accounting standards rests with the entity's directors and management. Key estimates and assumptions that support accounting treatments and financial statement disclosures may be affected by risks related to the climate. Therefore, we strongly advise management and directors to take climate risks into account as part of their risk assessment process and consider how this may affect the creation of financial statements (and climate statements for CRD reporting entities).

Despite the fact that accounting standards do not specifically addresses climate-related issues, entities are still required to take them into account when they have an impact on the financial statements as a whole. Information is considered material if it could reasonably be expected that its omission, incorrect representation, or concealment would affect the decisions of the primary users of financial statements and climate statements.

The integration of climate-related disclosure into financial decision-making is still being improved by numerous investors, financial institutions, and other parties in the private sector. Leaders in the public sector have also stressed the significance of financial markets being transparent about issues related to climate change. Investors and other demands for the disclosure of climate-related information are crucially important. Large asset owners and asset managers in particular are at the top of the investment value chain and, as a result, have a crucial role to play in persuading their portfolio companies to make better financial disclosures

about climate change. Investors anticipate that, where relevant, the implications of the financial statements will also be included in an annual report along with information that is strategically significant. This is in line with the TCFD's expectation that climate-related financial disclosures will be included in standard filings. With this strategy, investment choices and stewardship are more carefully considered. Therefore, entities should concentrate on providing information in a clear, succinct, and efficient manner to avoid losing important information in detailed explanations of the situation and the financial implications. This entails revealing any sources of estimation uncertainty as well as the primary hypotheses that support asset values, impairment, and pertinent provisions that could be significantly impacted by climate risk.

Abbreviations

TCFD	Task Force on Climate-Related Disclosures
FSB	Financial Stability Board
EGX	Egyptian Exchange
ISSB	International Sustainability Standards Board
CRD	Climate Risks Disclosure
CDSB	Climate disclosure standards board
FR	Financial reporting
CRM	Climate risk management
FRA	Financial Regulatory Authority
ROA	Return on Asset
FS	Firm Size
TQ	Tobin's Q

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