CLIMATE RISKS REPORTING PRACTICES AND ASSURANCE

Edited by Ahsan Habib, Dimu Ehalaiye, Ainul Islam and Sedzani Musundwa

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Ahsan Habib dedicates this book to his wife Rehena and his children Fariha and Farjad.

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EDITORIAL CHAPTER: CLIMATE RISKS REPORTING PRACTICES AND ASSURANCE

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ABSTRACT

The intensifying climate crisis has raised the importance of climate risk reporting and assurance as a key priority for academics, practitioners and other key stakeholders. Climate risk, which includes both physical and transition risks, has significant repercussions for businesses, economies and societies. Although regulatory initiatives are on the rise, climate risk reporting remains predominantly voluntary and inconsistent across different jurisdictions and sectors, posing challenges for stakeholders who seek comparable, reliable and decision-useful disclosures. Furthermore, the assurance of climate-related disclosures remains underdeveloped, characterized by inconsistent standards and limited research on its effectiveness. This issue explores the evolving domain of climate risk reporting and assurance, highlighting major challenges, emerging trends and regulatory developments. The collective research in this issue addresses critical gaps in current practices, offering insights into stakeholder responses, the quality of reporting and challenges related to assurance. By fostering enhanced transparency and comparability in climate risk disclosures and assurance practices, this issue strengthens existing practices and contributes to advancing global sustainability goals.

Keywords: Climate risk reporting; assurance practices; regulatory initiatives; global sustainability goals; stakeholders

INTRODUCTION

The exacerbating climate crisis and its profound implications for businesses, economies and societies have intensified the focus on climate risk reporting and assurance practices (CRRAP) (Moses & Hopper, 2022; Tauringana & Moses, 2023). Climate risk has been considered a long-term risk factor (Krueger et al., 2020), with consequential implications for the global economy and financial capital markets (Bolton & Kacperczyk, 2023; Hsu et al., 2023). Climate risk is broadly categorized into physical climate risk and transition climate risk. Physical climate risk refers to financial losses and disruptions caused by climate change-related events, such as extreme weather conditions and rising sea levels. In contrast, transition climate risk emerges from the economic and regulatory costs associated with transitioning to a lower-carbon economy, driven by evolving climate policies and regulatory frameworks.

As sustainability and environmental, social and governance (ESG) considerations continue to gain global momentum, the demand for transparent, accurate and credible disclosures on climate-related risks has become increasingly critical (Ehalaiye, Moses, Laswad, et al., 2025; Freedman & Jaggi, 2009). This is not merely an issue impacting corporate responsibility but a fundamental necessity for fostering stakeholder trust, enabling informed decision-making and promoting sustainable business practices in an era of heightened regulatory and societal accountability. Understanding the current landscape of climate risk reporting, including its key drivers and broader implications, is imperative for enhancing disclosure quality and ensuring that businesses effectively manage and appropriately communicate their climate-related financial risks (DiSalvio & Dorata, 2014).

However, a significant challenge in credible climate risk reporting is the absence of uniformity in sustainability disclosure standards. Despite notable advancements, such as establishing the International Sustainability Standards Board (ISSB) in 2021 and the release of Sustainability Disclosure Standards (IFRS S1 and IFRS S2) in 2023, climate risks and ESG-related reporting predominantly remain voluntary. This voluntary nature exacerbates inconsistencies, reduces comparability and ultimately diminishes the reliability of disclosures, leaving stakeholders to navigate a fragmented and often opaque reporting landscape. Empirical research suggests that mandatory climate-related risk disclosure enhances the quality and reliability of reporting compared to voluntary approaches (Bolton & Kacperczyk, 2021; Ehalaiye, Moses, Laswad, et al., 2025). Yet, in the absence of stringent regulatory requirements, organizations and accounting professionals face mounting pressure to align their reporting practices with evolving societal and regulatory expectations. The challenge of navigating these complexities is profound, requiring firms to balance transparency, compliance and strategic risk management in an increasingly scrutinized business environment.

Transparent climate risk reporting is essential, as it plays a critical role in maintaining stakeholder confidence and reinforcing corporate accountability. By providing clear and verifiable disclosures, organizations enable stakeholders to

assess their resilience to climate risks and their alignment with global sustainability objectives. However, in the absence of credible assurance, concern about greenwashing and misleading corporate signalling persist, ultimately undermining trust in sustainability-related disclosures. Empirical evidence suggests that audited ESG reports are perceived as more reliable, reinforcing the value of independent assurance in enhancing disclosure credibility (IFAC, 2022; Zhou, 2022). Assurance practices enhance and not only strengthen stakeholder confidence but also shield companies from reputational risks associated with misleading sustainability claims. Despite these benefits, the assurance landscape remains fraught with challenges, including inconsistent assurance standards and a lack of comprehensive research into how assurance practices influence both reporting quality and investor perceptions. To address these knowledge gaps, further exploration of the role of assurance in reinforcing the credibility of ESG disclosures is essential. A more standardized and rigorous assurance framework would help mitigate inconsistencies, enhance comparability and ensure that sustainability disclosures meaningfully contribute to informed decision-making and long-term corporate accountability.

DEEPENING CLIMATE RISKS REPORTING PRACTICES AND ASSURANCE KNOWLEDGE

This volume offers novel insights into the evolving landscape of CRRAP. Drawing on contributions from scholars and industry experts worldwide who employ diverse methodologies, it enhances our understanding of these critical areas. In this emerging research field, the extant literature has largely focused on the nature of climate change risks (Braasch & Velte, 2023; Daddi et al., 2018; de Grosbois & Fennell, 2022; Estrada & Botzen, 2021), the need to report the financial impact of these risks (Borghei et al., 2024; Ehalaiye, Moses, Laswad, et al., 2025; Tsang et al., 2023; Zhou, 2022) and the prospects for assuring information related to these risks (Boiral et al., 2019, 2020; Bouten & Hoozée, 2025; Datt et al., 2018, 2020; Dutta & Dutta, 2021). However, there remains a significant gap in understanding how firms and organizations report climate-related risks, particularly given the non-uniformity of standards and the mostly non-mandatory nature of reporting these risks. Similarly, the assurance of climate-related information is neither standardized nor mandatory in most jurisdictions. Hence, it is important to seek evidence on current practices on climate risks reporting and assurance, to foster a deeper understanding of the benefits, challenges and future directions of these practices. Collectively, the research contained in this issue addresses these research gaps and contributes to the discourse on climate risks reporting and assurance in several ways.

Firstly, the volume examines various practices of climate risks reporting in different jurisdictions and sectors, across developed and developing markets and corporate to the public sector, providing a broad range of perspectives on how various firms and organizations are approaching climate risks reporting. Secondly, the volume documents stakeholder actions and responses to new

standards/regulations such as IFRS S1 and S2, in concert with existing reporting frameworks such as the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP). Thirdly, it highlights, challenges in assurance processes for climate-related information and reflects on prominent concerns to consider in facilitating credible practice for the assurance of climate-related information to be beneficial to stakeholders. Finally, by offering insights into current practices, this volume deepens our understanding and supports the progress of the Sustainable Development Goals (SDGs), particularly SDG 13, which emphasizes the need for collective efforts to take urgent action against climate change and its effects (Moses & Tauringana, 2022).

CONTRIBUTIONS TO THE SPECIAL ISSUE

This volume's research documents important findings about climate risks reporting practices and assurance across multiple jurisdictions. Seven chapters were accepted for this issue, with two quantitative papers using data from the United States, two papers from New Zealand, two from South Africa (with one's scope covering Sub-Saharan African) and one from Nigeria. Fig. 1 maps out the papers by region and methodology employed.

Key summaries from each of the contributions in the volume are discussed next.

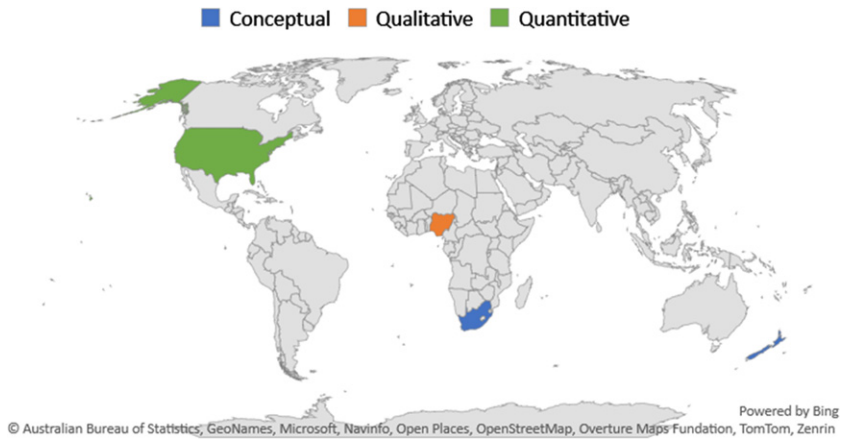

Fig. 1. Submission Analytics.

Sanusi et al. (2025) open the volume. This work provides key insights into CRRAP, focusing on its significant aspects, emerging issues, and evolving trends. It explores how CRRAP drives investments in green assets and infrastructure, highlighting its potential to mitigate the impacts of climate change and support a

sustainable global economy. The study adopts a conceptual approach, drawing on academic research, case studies and global reporting standards to comprehensively understand CRRAP. It examines historical developments, regulatory frameworks and theoretical perspectives to present a detailed analysis of these practices and their implications. This chapter contributes to the literature by offering a comprehensive exploration of CRRAP, situating it within historical, regulatory and theoretical contexts. Additionally, it identifies gaps in current practices and suggests pathways to improve transparency, comparability and accountability in climate risk reporting and assurance.

Grebe (2025) explores the need for a contextualized, stakeholder-oriented approach to environmental reporting. Its primary aim is to identify the specific stakeholder groups the organizations report to and determine the extent to which organizational and stakeholder perspectives converge. The chapter seeks to address gaps in inclusivity by proposing a framework for generating environmental reports that meet the varied expectations of distinct stakeholder groups. The study employs a conceptual framework grounded in stakeholder theory, supported by an analysis of existing sustainability standards and reporting frameworks, such as IFRS S1 and S2, the GRI and the CDP. It also references industry and academic insights to outline practical implications for improving stakeholder-inclusive environmental reporting. This chapter contributes to the literature by proposing a stakeholder-focused approach that bridges the gap between standardized reporting frameworks and the specific needs of stakeholders. Furthermore, it provides a research agenda for advancing methods to identify and address stakeholder-specific concerns in environmental reporting.

Okwuosa (2025) investigates the quality of climate-related performance disclosures by early adopters of IFRS S2 in Nigeria and examines the motivations behind their decision to adopt the standard early ahead of their peers. It aims to assess compliance with IFRS S2 metrics and targets and explores how these early adopters signal their commitment to climate-related sustainability practices. A qualitative research design was employed, involving content analysis of sustainability reports from four early adopters of IFRS S2 and seven semi-structured interviews with sustainability officers, accountants and consultants. The study provides the first empirical evidence on the quality of climate-related disclosures by IFRS S2 early adopters in Africa. It highlights the need for capacity building and regulatory support to improve disclosure practices and foster successful adoption. The research also contributes to the literature on the motivations behind early adoption, demonstrating how companies use IFRS S2 as a strategic tool to signal leadership and attract investment while exposing gaps in actual performance.

Ehalaiye, Moses, and Botica Redmayne (2025) examine the development and effectiveness of New Zealand's climate-related assurance standards for Climate Reporting Entities (CREs). The primary objective is to evaluate the progress made in establishing assurance mechanisms under the country's climate-related disclosure regime and to provide reflective insights into how these regulatory expectations can be successfully realized within New Zealand's professional and regulatory landscape. The study adopts a conceptual approach, analysing various

regulatory documents. It also reflects on recent developments, including consultation processes and amendments proposed by the External Reporting Board (XRB). The chapter synthesizes these findings to assess the readiness of CREs and the assurance market. This chapter contributes to the discourse on sustainability assurance by critically evaluating New Zealand's climate-related disclosure regime. It underscores the importance of balancing regulatory timelines with the need for consistent and high-quality assurance practices. The findings offer valuable insights for policymakers, preparers and assurance providers seeking to enhance the credibility and reliability of climate-related disclosures.

Erasmus et al. (2025) systematically review CRRAP within sub-Saharan Africa's public sector. It aims to assess challenges, including materiality and cost–benefit constraints, while proposing a conceptual framework to enhance these practices. The broader goal is to advance responsible governance and align public sector efforts with global sustainable development targets. The chapter employs a systematic literature review and highlights significant barriers to climate risk reporting and assurance in the sub-Saharan African public sector. This chapter offers a valuable contribution by presenting a conceptual framework tailored to sub-Saharan Africa's unique challenges and opportunities in climate risk reporting and assurance. It underscores the need for robust legal frameworks, multi-stakeholder partnerships, capacity building and financial investment to enhance reporting practices.

Kaspereit (2025) introduces a comprehensive, survivorship bias-free dataset of firms committed to or having set Science Based Targets (SBTs). SBTi is a collaborative effort that helps firms set emission reduction targets aligned with the Paris Agreement. Once firms commit to setting targets, they immediately appear on the SBTi dashboard. While the SBTi dashboard provides no updates when a firm submits its targets, it acknowledges the final setting of targets. Since February 2023, firms failing to submit or get targets approved within 24 months are flagged as 'commitment removed' rather than being silently removed from the dashboard, as was the case before. The author considers this to be an interesting research setting: regime shift from a silent removal process to a transparent 'name-and-shame' approach. Since the SBTi does not provide historical archives of its dashboard, this poses a major challenge for research aimed at understanding why firms fail to meet their commitments. The main contribution of this chapter is the construction and description of a dataset based on monthly snapshots from the Internet Archive of the SBTi dashboard, dating back to its inception in September 2015 and extending up to September 2024. The author expects that this dynamic and survivorship bias-free view on the target-setting process will enable researchers to address a wide range of relevant questions.

Li et al. (2025) examine whether climate risk influences accounting-based equity valuation by observing how investors adjust their relative valuation weights on different accounting variables when facing climate risk. The authors use a log-linear valuation model with the valuation weights measured by the elasticities of market prices with respect to the book value of equity and earnings. The authors use the annual global anomaly temperature as a proxy for climate risk. Using a large sample of US firms, the authors find the association of climate

risk with the elasticity of book value is positive but the association with the elasticity of earnings is negative. The authors also find that the association varies across industries and appears to be long-run rather than short-run. This chapter contributes to the climate finance literature by documenting the important role of accounting information in valuing climate risk. This chapter further contributes to the literature on the value-relevance of accounting information by identifying climate risk as one of the potential underlying economic drivers.

CONCLUSION

As climate risks continue to reshape global businesses, economies and societies, the stakeholders are asking for robust, transparent and credible climate risk reporting that is appropriately assured. By reporting on practices across multiple jurisdictions and sectors, this issue highlights the fragmented nature of current disclosure practices, the ongoing challenges of voluntary and inconsistent reporting standards and the limited but growing role of assurance in enhancing the credibility of climate-related information. While regulatory initiatives such as IFRS S1 and S2 represent steps towards greater standardization, significant gaps remain in ensuring comparability and reliability across jurisdictions.

The research presented in this volume underscores the critical role of climate risk disclosures in guiding sustainable business practices and supporting global sustainability efforts. It also identifies the pressing need for further empirical research on the assurance of climate-related disclosures, particularly in developing markets where regulatory oversight is still evolving. By addressing these challenges, the studies contribute to the broader discourse on accountability and transparency in climate risk reporting, paving the way for future advancements in standard-setting and assurance practices.

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NAVIGATING CLIMATE RISKS: REPORTING PRACTICES AND ASSURANCE FOR A SUSTAINABLE FUTURE

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ABSTRACT

There has been increasing global attention on climate-related risk management in relation to environmental, social and governance (ESG) initiatives. This includes the recently established International Sustainability Standards Board (ISSB) to deliver a comprehensive framework on climate-related disclosures. With this development, interest in climate-risk reporting and assurance is growing to enhance users' confidence in sustainability and non-financial reporting. Therefore, this book chapter provides key insights into climate-risk reporting practices and assurance (CRRPA). It covers subject matters related to climate-related information. This chapter identifies significant aspects of CRRPA and highlights key trends and evolving issues. Hence, CRRPA can increase organizations' investment in green assets and infrastructure as an opportunity to mitigate the adverse impacts of climate change for a sustainable global economy.

Keywords: Climate; climate change; assurance; reporting practices; risks

1. INTRODUCTION

In the present climate change–constrained world, organizations are implementing active climate-risk management and assurance procedures to mitigate potential risks, embrace climate change opportunities and improve resilience to gain the trust and confidence of stakeholders (Sebos et al., 2023). Climate-risk reporting

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practices and assurance (hereafter CRRPA) is the identification, assessment, management and reporting of climate change risks and their impacts on organizations and the global community. Assurance practices are the process of validating or giving assurance to concerned stakeholders that businesses or organizations disclose actions related to climate risks in an accurate, transparent and reliable manner. Typically, it is a statement of proof that information disclosed as climate risk is of good quality and authentic after the climate-related information, data, processes and controls have undergone independent assessment and verification (Zhou, 2022). This will enhance the trust and credibility of the CRRPA (Braasch & Velte, 2023).

However, CRRPA evolved in response to the increased recognition of the impacts that climate change can have on economies, businesses, the environment and society at large. This development can be traced to several key responses, like increased awareness of climate change impacts, industry initiatives and standards, a shift in the regulatory landscape, stakeholder vs investor pressure on the need for environmental, social and governance (ESG) investment and increased demand for transparency and accountability.

Moreover, climate-risk reporting practices are crucial for stakeholders like governments, communities, investors and organizations in decision-making on various issues (Acharyya et al., 2019; Borghei et al., 2024; Garg et al., 2023). These practices are briefly explained as follows:

Government: Climate reporting agencies and policymakers use climate-risk reports or information to set targets and monitor progress towards climate goals. These reports inform regulations and policies to reduce carbon emissions and promote sustainability practices.

Communities: Climate-risk reporting practice and assurance can guide local communities and organizations in understanding the potential impacts of climate change on their livelihoods, environment and overall well-being. This also helps in increasing their efforts to adapt to unavoidable climate change impacts.

Investors: CRRPA enable better investment decisions by providing significant insight into climate change risks and opportunities. Hence, investors can assess the sustainability and long-term impacts of climate change on their investments. In recent times, climate-risk reporting is a key factor that prompt investors to focus on green investment (Borghei et al., 2024).

Organizations: CRRPA help businesses develop strategies to mitigate climate change risks and capitalize on opportunities that promote business continuity and resilience. Therefore, CRRPA are crucial for informed decision-making across diverse corporate sectors. The quality of the information reported directly influences the effectiveness of strategies to address climate change and its impacts.

Over the years, studies have shown and provided overwhelming evidence about the threat of climate change to the ecological system and social and

economic lives. The negative effects of climate change are increasingly evident in the growing global environmental, social and economic crises. For example, the recent rise in biodiversity loss is linked to climate change, which is causing shifts in species of living organisms, some of which are on the brink of extinction-posing a great danger to the global ecosystems. The rise in sea levels, driven by the rapid melting of the Antarctic and Greenland ice sheets, and the swift increase in global temperature compared to the 19th century are particularly concerning. This leads to widespread droughts and heatwaves globally. From an ecological point of view, the rise in temperature is also threatening global food security (Estrada & Botzen, 2021; Fernandez & Trasande, 2024).

Other examples of climate change impacts include floods, wildfires, water scarcity and the displacement of communities leading to the destruction of livelihoods. These events disproportionately affect vulnerable populations, with significant social and economic repercussions. Economic costs associated with climate change also include damage to infrastructure, food shortages/increases in food prices and a decline in the global standard of living. These examples indicate the urgent need for comprehensive action to mitigate climate change and protect our ecological, social and economic well-being (De Grosbois & Fennell, 2022).

This has prompted calls for increased transparency and accountability in how businesses are addressing climate change-related risks (Fernandez & Trasande, 2024). This also includes a series of changes in the climate-related regulatory landscape, in which countries have mandated both environmentally sensitive and non-environmentally sensitive industries to disclose carbon emissions and climate-related risks, including strategies for mitigating these risks (Kryk & Kożuch, 2024; Thai et al., 2022). However, the rate of compliance and penalty could differ based on the gravity of the damage caused to the ecological system. An example is the Task Force on Climate-Related Financial Disclosures (hereafter TCFD), established by the Financial Stability Board (FSB), which developed voluntary frameworks for businesses to publish climate-related financial reports (Ehalaiye et al., 2025; Garg, 2023). As a result of this development, some countries have implemented mandatory sustainability reporting of climate impacts including actions taken to mitigate them (Karamaneas et al., 2023; Katirtzidou et al., 2023; Ruane et al., 2024).

In addition to this, there is an era of increasing transparency and accountability, where stakeholders are pressuring businesses to account for the risks, they face from climate change and the efforts they make to address them in an open and honest manner. This will demonstrate a commitment to sustainability and responsible business practices. In practice, CRRPA promotes green investment both in assets and infrastructure, as it allows investors to assess and analyze their exposure to climate-related risks and opportunities and integrate findings into their investment decisions.[1] As a result, investors have developed an interest in ESG-related factors in their climate-related investments (Comoli et al., 2023; Comyns, 2018).

The industry-led efforts and standards created to direct organizations in reporting on climate-related risks and opportunities are another intriguing and new development in the CRRPA. One such platform is the Carbon Disclosure

Project (CDP), which allows companies to reveal their greenhouse gas emissions and risks associated with climate change (Bedi & Singh, 2024). Among these is the Global Reporting Initiative (GRI), which offers standards for reporting sustainability and the effects of climate change (Giannarakis et al., 2023). Perhaps, due to the urgent need to address climate change and its consequences on people's socio-economic conditions, these practices are vital in supporting businesses with their climate-risk reporting and assurance procedures. These practices represent a paradigm shift in sustainability and resilience in business processes (Hazemba, 2024; World Health Organization, 2022).

2. AN OVERVIEW OF THE HISTORY OF CRRPA

The history and evolution of CRRPA may be linked to the urgency of climate research in the late 19th and early 20th centuries, which significantly advanced scientific understanding of climate change. This improves the early identification of climate change as a serious worldwide problem (Malik & Ford, 2024). Subsequently, this led to the development of frameworks, standards and recommendations for regulations that addressed the risks associated with climate change. The CRRPA programme, which encourages assessments of climate effects and opportunities as well as measures to lessen its threat, is one of the current developments in the field. Nonetheless, awareness of the impact of greenhouse gases on both humans and the environment started to emerge in the late 1800s. By the 20th century, researchers had laid important groundwork for understanding the origins and effects of climate change (Cointe & Guillemot, 2023).

The 1992 Rio Earth Summit, also known as the United Nations Conference on Environment and Development (UNCED), is another important turning point in the history of the CRRPA. It is recognized as a turning point in the field of global environmental governance. The United Nations Framework Convention on Climate Change (UNFCCC), which aims to lower greenhouse gas emissions in the atmosphere and avoid harmful human interference with the ecosystem, was adopted during this summit (Wright et al., 2023).

The Kyoto Protocol of 1997, an international environmental management agreement governed by the UNFCCC, came next. It set legally binding emission reduction objectives for industrialized (developed) nations. Frameworks for projects including the Clean Development Mechanism (CDM) and carbon trading were also established under the treaty. The Kyoto Protocol emphasized that participating nations must disclose greenhouse gas emissions and environmental efforts in a transparent manner (Susilowati et al., 2024; Wright et al., 2023).

Nevertheless, in the late 20th century, corporate environmental reporting gained famous recognition for stressing the importance of environmental impacts and performance disclosure by corporate organizations. The concept of corporate environmental reporting begins as a voluntary initiative to an advanced structured standard like the GRI, which provides frameworks for reporting on

climate-related issues, sustainability to be specific (Giannarakis et al., 2023; Ivanova, 2012). Meanwhile, the concept of the 'Triple Bottom Line' (TBL) was introduced by John Elkington in 1994 to challenge organizations to focus on social and environmental performance rather than solely on profit maximization. The following are some of the early milestones for environmental reporting:

John Elkington's Book (1997): Elkington's book on TBL was published in 1997, and it was named The TBL of 21st Century Business. It emphasizes the need for organizations to account for the social, environmental and economic impacts of their operations within their communities. It sets the tone for promoting the TBL framework.

The Global Reporting Initiative (GRI) (1997): The GRI was established in 1997 to create a standardized framework for sustainability reporting. It allows businesses to measure and communicate their environmental, economic and social performance to the stakeholders.

United Nations and International Council for Local Environmental Initiatives (ICLEI) (2007): Another significant milestone in TBL development came in 2007 with the United Nations and the ICLEI. This collaboration integrated TBL into public sector accounting and established standards for metropolitan and public accounting on sustainable TBL practices. These standards have laid the foundations for shaping sustainability reporting practices.

Moreover, the Intergovernmental Panel on Climate Change (IPCC) assessment reports were established in 1990. Their purpose is to publish climate change assessment reports and summaries of the latest scientific research findings on climate change. The report serves as a foundation for information dissemination for businesses, policymakers and the public about the science of climate change and its potential impacts (Scott et al., 2023).

In addition, the TCFD was established in 2015 by the FSB to develop voluntary frameworks for disclosing climate-related financial information. The TCFD recommendations provide guidelines for businesses to disclose information about their climate-related risks, opportunities, governance, strategy and metrics. This is closely aligned with CRRPA (Braasch & Velte, 2023; Garg, 2023).

Nonetheless, in the present 21st century, the concept of regulatory development arises, where governments around the world have implemented various regulatory frameworks to enforce climate-risk reporting. For example, the European Union (EU) introduced the Non-Financial Reporting Directive (NFRD), requiring environmentally sensitive companies to disclose non-financial information and environmental and social issues in their annual reports (Turzo et al., 2022). Countries like New Zealand, Australia and Canada have also introduced mandatory reporting requirements for climate-related risks (Ehalaiye et al., 2025). Also, the growing amount of investors focusing on ESG factors in investment decisions in the 21st century marked a historical development in CRRPA. In recent times, investors have incorporated ESG factors into their

investment decisions. This has led to a greater demand for transparency in climate-risk disclosures from businesses (Comoli et al., 2023).

Another historical development in CRRPA in the 21st century is the establishment of assurance services, which promotes a wide recognition of CRRPA. Assurance services verify the accuracy and reliability of climate-related information. This involves the responsibility of audit firms and specialized sustainability consultants tailored to climate-risk reporting (Pizzi et al., 2024).

Thus, the evolution of reporting standards and frameworks is an ongoing initiative for climate-risk reporting as it evolves in response to changing stakeholder expectations, regulatory requirements and expectations for best practices. In recent times, agencies like the GRI, CRRPA, CDP and Sustainability Accounting Standards Board (SASB) have played key roles in developing and promoting reporting standards for climate-related issues. Therefore, the history of CRRPA reflects the growing recognition of climate change as a material business matter that has critical roles of risk management, transparency and accountability in addressing climate-related risks and opportunities.

3. THE PARIS AGREEMENT AND CRRPA

The Paris Agreement is a recognizable international treaty on climate change established in December 2015 at the 21st Conference of the Parties (COP21) to the UNFCCC. It is a landmark achievement in the global effort to address the urgent problems of climate change by encouraging countries to take desirous actions to limit global warming and reduce its impacts (Andersen, 2024; Estrada & Botzen, 2021).

However, the scientific agreement that global warming exceeding 2 degrees Celsius (°C) above pre-industrial levels could have severe and irreversible consequences for people and the planet is a major concern for the global goals of the Paris Agreement. Meanwhile, one of the significant aims of the Paris Agreement is to limit global temperature thresholds to 1.5°C. Based on this reason, each member country is required to submit a nationally determined contribution (NDC), which highlights its climate action plan and commitments to reducing greenhouse gas emissions and should be subjected to periodic review (Estrada & Botzen, 2021). Hence, the agreement stipulates the need for transparency and accountability to ensure that the participating countries fulfil their commitments by regularly reporting emissions mitigation progress in line with NDC guidelines (Chai et al., 2017).

The agreement also establishes a mechanism for five-yearly assessments called global stock take to review progress on climate actions on emissions reductions, the financial support provided and received in the cause of climate change treatment mitigation, and adaptation efforts. Part of these efforts is climate finance, where developed countries mobilize both public and private financiers to provide annual climate assistance funds to developing nations to finance climate mitigation and adaptation efforts. Adaptation efforts focus on adapting to climate impacts by vulnerable communities, including loss and damage that

cannot be prevented or adapted to. The agreement also recognizes the benefit of technology in capacity building to support developing countries in their climate mitigation and adaptation efforts (Chai et al., 2017; Wright et al., 2023). Although there has been debate over which developed or developing countries are to blame for climate change and which country should be more responsible for kerbing emissions?

Developing countries accused developed countries of emitting more greenhouse gases, saying developed countries should carry the burden due to their enormous industrial growth. The United States was found to be the number one emitting country, followed by the EU (Friedrich et al., 2023). Since the Paris Agreement, climate experts have concluded that countries' pledges are not ambitious enough and will not be enacted quickly enough to limit global temperature rise to 1.5°C. Therefore, the Paris Agreement represents a historic global treaty that sets the framework for international cooperation to address climate problems. Meanwhile, its success depends on the ambitious and coordinated efforts of participants and other stakeholders to reduce greenhouse gas emissions and build resilience to climate impacts (Chai et al., 2017). As of 2023, 194 countries, including the EU, have agreed to and ratified the Paris Agreement, representing over 98% of the consensus to kerb global greenhouse gas (GHG) emissions. This includes China and the United States which are the major global carbon emitters. However, some countries are neither committed nor validate this agreement and thereby backtracked on their pledges. An example is the United States, under the Trump administration, Trump formally withdrew from the Paris Agreement in 2020, although it was later ratified under the Biden administration. Countries, like Türkiye and Russia were criticized for setting unambitious targets on carbon emissions. Also, it was reported that many countries are not doing enough to meet the global 2030 emission reduction targets (Borghei et al., 2024; Braasch & Velte, 2023).

4. STATE-OF-THE-ART BETWEEN THE PARIS AGREEMENT AND THE CRRPA

The Paris Agreement and the concept of the CRRPA are intricately linked, indicating increasing recognition of the need for transparency and accountability and effort in addressing climate change. The interconnection between the Paris Agreement and the CRRPA is through the objectives of promoting transparency and accountability, risk management, investors' and stakeholders' expectations, financial stability and resilience in kerbing climate change including policy alignment and support (De Grosbois & Fennell, 2022). Considering similarities in the aspects of *transparency and accountability*, both the Paris Agreement and the CRRPA recognized efforts to mitigate climate change with truth and honest commitment. In terms of financial support received and provided in the cause of mitigating climate change, emissions reporting, mitigation efforts and adaptation efforts, the CRRPA has extended its commitment to transparency and accountability to corporations and financial institutions, requiring them to report

and publish their exposure to climate change and opportunities and how they are managing the risks involved (Estrada & Botzen, 2021; Zhou, 2022).

Another area of similarity between the Paris Agreement and the CRRPA is *risk management and assessment*; hence, both emphasize the importance of assessing and managing climate-related risks to promote adaptation and mitigation efforts. Both the Paris Agreement and the CRRPA require businesses to identify, assess and disclose exposure to transitional and physical climate-related risks and liabilities associated with climate change.

Similarity related to investor and stakeholder expectations: While the Paris Agreement enlightens the global community on the influence of investors and stakeholders in addressing climate change, stakeholders are increasingly demanding transparency and disclosure regarding climate-related risks and opportunities in the CRRPA. Both provide a framework for meeting these expectations by offering guidelines and the best methods to assess and disclose climate-related risks.

Similarity related to financial stability and resilience: The Paris Agreement's goals are to enhance the resilience of participating countries to climate change impacts and transition to green energy economies. While CRRPA helps businesses identify and address risks to their financial stability and resilience. This can foster the achievement of the Paris Agreement goals. In addition, international organizations like the IPCC and the Network for Greening the Financial System (NGFS) have concluded that climate change poses significant risks to the resilience and financial stability of businesses (Scott et al., 2023).

Policy alignment and support: Both the Paris Agreement and the CRRPA provide standard frameworks and measures for assessing and reporting climate-related risks, which enhance the implementation of climate change policies at national and international levels. They also provide an opportunity to review climate policies and strategies to meet long-term objectives and adjustments in line with the change in climate conditions. Overall, the alignment between the Paris Agreement and the CRRPA will contribute to global efforts to address climate change and achieve sustainable development.

5. WHAT IS CLIMATE RISK?

Climate risk refers to the potential negative impacts that climate change and extreme weather events can have on society, the economy and the environment. These risks can manifest as physical risks such as damage to infrastructure from storms or rising sea levels; transition risks such as regulatory changes or shifts in market preferences impacting businesses and liability risks such as legal action against companies for non-compliance with climate regulations (Nobanee & Nghiem, 2024; Thai et al., 2022). Climate risk affects different sectors and regions differently, depending on geographical location, socio-economic conditions and adaptive capacity. Addressing climate risk often involves assessing vulnerabilities, implementing mitigation and adaptation strategies and incorporating climate considerations into decision-making processes across different