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Risks in Islamic Green Finance and Takaful as A Solution

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ABSTRACT

Islamic green finance faces unique risks that require careful consideration and mitigation strategies in promoting the success of sustainable projects. This paper highlights Takaful, with its unique risk-sharing mechanisms, Shariah compliance, and community-based approach, can offer valuable and innovative solutions to address these risks and enhance the viability of Islamic green finance in promoting sustainable development and environmental responsibility. This research employs a qualitative approach through secondary data analysis. This paper, meticulously crafted based on an extensive analysis of documents and reports from financial regulatory and supervisory bodies, multilateral organizations, and industry experts, examines the integration of climate risk considerations into Takaful sector business models, encompassing both the challenges and opportunities arising from climate-related risks. By addressing the key challenges and seizing the opportunities, insurance and takaful operators' (ITOs) can play a leading role in building a more resilient and sustainable future. Indeed, by leveraging ITOs' strengths, Islamic green finance institutions can enhance the viability and impact of their investments, effectively manage risks, promote sustainable practices, and contribute to a more sustainable future.

1. Background

Climate change refers to a long-term shift in global or regional climate patterns. The landscape of climate change risk is evolving rapidly, recognised as a top global threat and affects human, societal, environmental and economic systems through rising temperatures, rising sea levels, and increasing frequency and severity of natural catastrophes and extreme weather-related events. As highlighted in a recent sigma report, natural catastrophes cost the world USD 275 billion in 2022. Insurance covered 45% of the damage, at USD 125 billion (Banerjee & Bevere, 2022). Facts are that the climate protection gap is real, climate risk is not properly priced and capital markets and public private partnerships are key to unlocking the additional needed funding. This protection gaps the difference between what is covered and actual losses – is significant. Additional tools in tackling the protection gap.

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Several notable scientific studies have explored the nature of climate change risk and its underpinning drivers (Golnaraghi, 2022). Scientific consensus has attributed specific natural catastrophe events to human induced as the main drivers for increased and more costly liability risks from increased climate-related insurance claims. For instance, the IPCC documented that strong scientific evidence suggests that the frequency, severity, and distribution of certain types of natural catastrophes and extreme weather events such as extreme heat, tropical cyclones, flooding, or wildfire is closely correlated with temperature increases. A recent study estimated that the proportion of Category 4 and 5 hurricanes has increased at a rate of approximately 25–30 % per °C of global warming. According to the Intergovernmental Panel on Climate Change (IPCC) (2021), climate change is changing the future likelihood of a wide range of risks (e.g., frequency, severity and geographic locations of extreme weather-related events). The extent to which weather patterns have already been affected is also unknown (The Geneva Association, 2018).

It is apparent that Small and Medium-Sized Businesses (SMEs) are systematically exposed to the consequences of natural catastrophes. For instance, an earthquake in Turkey is estimated to have cost SMEs anything from $1.1 to $4.5 billion (Abuhussein et al., 2023; Mahadi, 2023). Similar to this, 557,637 businesses—of which 90% were SMEs—were badly impacted by floods in Thailand (Mavrodieva et al., 2019). Examples from Sri Lanka, where a 2016 cyclone caused major losses for SMEs, and Malaysia, where 13,000 SMEs collapsed as a result of flooding in 2014, highlight how vulnerable SMEs are to disasters of this nature (Setyoko & Kurniasih, 2022; Yadav et al., 2022), while in 2022, Malaysia was hit hard by seasonal flooding, forcing 66,718 people to evacuate and seek shelter in 116 relief centers (Hashim, et al., 2023).

Furthermore, amid natural disasters, even affluent nations struggle with problems. This fact is demonstrated by the significant economic loss of 5 billion pounds that the UK experienced during the Foot and Mouth Disease (FMD) epidemic in 2001 (Puspitarini & Setiawina, 2022). In the wake of frequent natural disasters like hurricanes, earthquakes, and floods, developing countries require robust insurance and takaful mechanisms to manage financial risks and facilitate recovery (Mills, 2004; Mahadi, 2023; Mahadi, & Ismail, 2021; Holzheu, & Turner, 2018).

Action and adaptation go hand in hand. Businesses, governments and individuals must respond to the risks we are facing now and start planning for those on the horizon. It is important to recognise that societal resilience relies on the extent of narrowing the protection gap and taking action to ensure that the climate crisis doesn't exacerbate existing inequalities. Failure to act will place a significant burden on households and businesses, as well as having a wider macroeconomic impact. Society's responses to climate change (including new policies, market dynamics, technological innovation, and social change) may have wide ranging impacts on the structure and function of the global economy.

2. Research Design and Methodology

This research employs a qualitative methodology to achieve a comprehensive understanding of the inherent risks within Islamic Green Finance. Against this backdrop, this paper is based on an in-depth literature review of documents and reports from financial regulatory and supervisory bodies, and multilateral organisations on integrating climate risk considerations into insurance sector business models and managing the challenges and opportunities arising from climate-related risks.

Selecting a qualitative research method requires selecting a range of methods and techniques that complement the selected research methodology. First, there are two types of research approaches including the inductive and deductive research approaches. This study employs an inductive approach, allowing for exploration of the research question without a priori hypotheses or statistical

testing. The researcher employed an inductive approach to investigate the research issues, analyzing specific data to develop broader understandings. This specialized research technique results in beginning the investigation with a generalization of the acquired data and then narrowing the data down to the specific research topic to arrive at strong findings with practical relevance.

Second, the research design serves as the foundation for effectively managing and systematically completing the study. The research design helps the researcher to select the technique for collecting and analyzing the data according to the type of study. Broadly categorized, research designs can be classified as descriptive, experimental, causal and correlational. For managing the current research, the researcher has selected the descriptive research design. This research design facilitates the exploration of risks inherent in Islamic green finance and investigates the potential of Takaful as a mitigating solution. The design will enable a comprehensive understanding of these issues through a qualitative approach.

This research aims to synthesize secondary data on integrating climate risk considerations into the insurance sector's business models. The data are collected from relevant academic publications (journal articles, research papers, editorials) and professional resources (websites, official documents, reports) published after 2018. This focus on recent publications ensures the data reflects the latest developments and insights on managing the challenges and opportunities presented by climate-related risks in the insurance industry.

This study employs a qualitative research design with an exploratory approach. By delving into this phenomenon, the study endeavours to illuminate novel and critical insights into the current risk landscape of Islamic green finance. In particular, the study focuses on the potential of Takaful as a mitigating mechanism for these identified risks.

3. Literature Review

Green finance, as articulated by Mahadi et al., (2024), encompasses two critical dimensions, i.e., the proactive mobilization of capital for environmental and climate initiatives (green financing) and the strategic integration of environmental and climate-related risks into financial management frameworks (greening finance). Islamic green finance is uniquely susceptible to a range of risks, necessitating robust and innovative mitigation strategies for the successful realization of sustainable projects (Al-Shaghdari et al., 2024; Daoulhadj & Hussin, 2023).

The core objective of green finance is to channel resources towards environmental betterment while simultaneously embedding environmental risk considerations into financial operations (Nasir & Ahmed, 2024; Daoulhadj & Hussin, 2023). Green finance is generally understood as the strategic deployment of capital towards ventures and initiatives that generate economic returns alongside tangible contributions to environmental sustainability and climate change mitigation (Nasir & Ahmed, 2024; Fu, et al., 2023). This perspective aligns with prevailing definitions in the literatures (Mahadi et al., 2024; Ozili, 2021), that similarly uphold these dual objectives of economic viability and ecological stewardship.

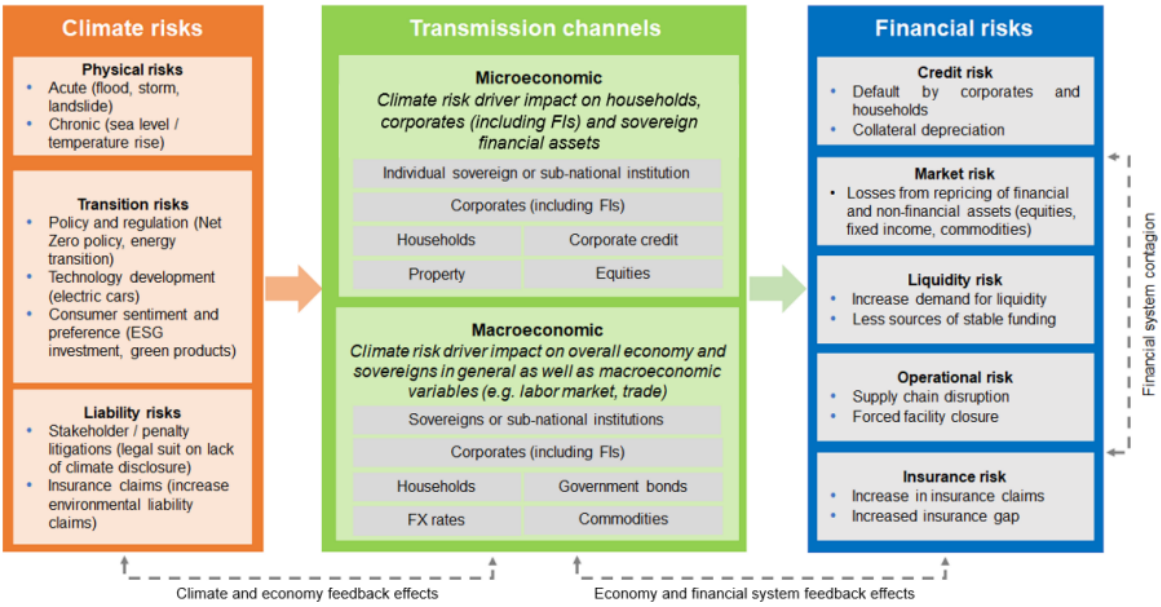
Takaful is indispensable for the sustainable growth and resilience of Islamic green finance initiatives, open doors for Takaful operators (ITOs) to emerge as leaders in facilitating a more resilient and ethically grounded transition to a sustainable economy (Mahadi, 2023). The integration of climate risk considerations into Takaful sector business models presents both formidable challenges and considerable opportunities. The challenges stem from the unprecedented scale and complexity of climate-related perils, including physical risks (e.g., extreme weather events) and transition risks (e.g., policy changes, technological disruptions).

Expanding on contemporary risk management strategies, Takaful/insurance schemes are

currently under rigorous investigation for their potential to provide crucial takaful/insurance coverage against highly specific environmental perils. These include, but are not limited to, agricultural losses stemming from climate-change induced crop failures and infrastructure damage impacting renewable energy installations (Njiforti, 2022).

The transmission of climate-related risks to existing financial risk types is a complex and evolving phenomenon. For ITOs, grasping how climate-related risks translate into existing financial risk types is crucial for their long-term stability, profitability, and positive societal influence; thus, proactive risk management, transparent disclosures, and innovative product development are essential for navigating this challenging environment.

Table 1. Transmission of Climate-Related Risks to Existing Types of Risks



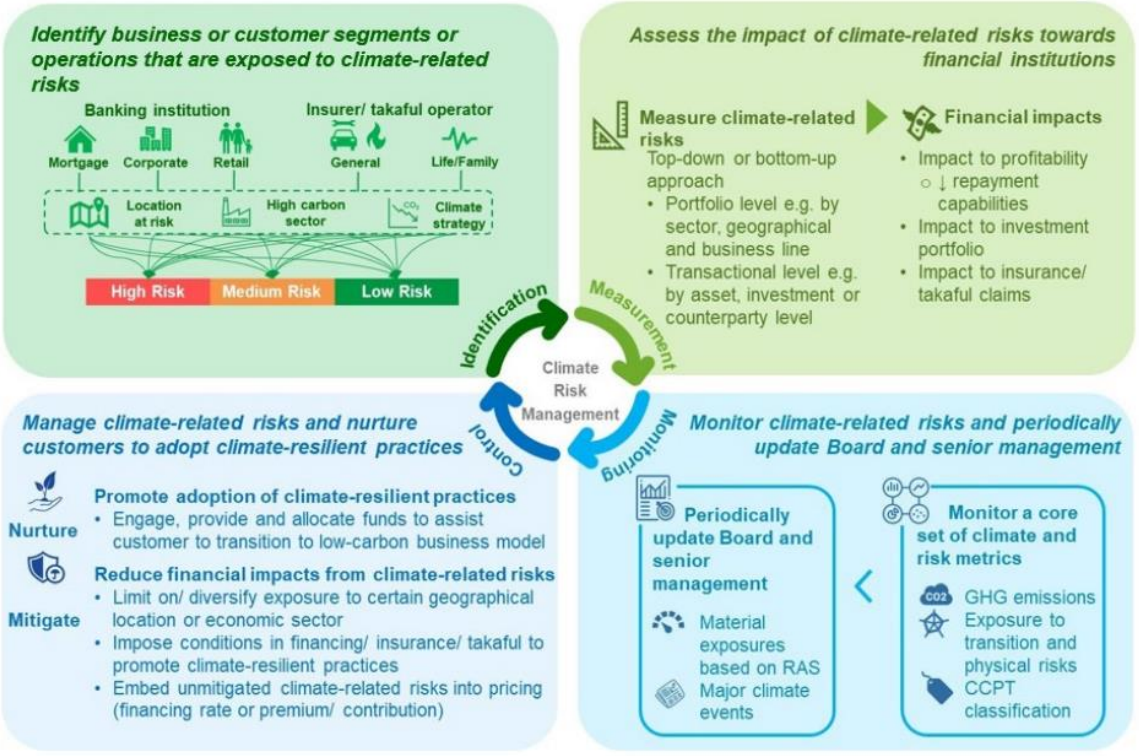
Source: Bank Negara Malaysia (BNM), (2025).

As illustrated by the BNM (2025) in Table 1, credit risk intensifies as severe weather events directly undermine corporate and individual repayment capacities, stemming from damaged assets, disrupted operations, and diminished collateral values, thereby escalating both probabilities of default (PD) and loss given default (LGD). Concurrently, market risk is profoundly influenced by shifting sentiments and regulatory changes concerning carbon-intensive sectors, precipitating volatile and often downward market valuations that lead to significant investment losses. The stability of financial institutions is further challenged by liquidity risk, as post-disaster scenarios trigger surges in deposit withdrawals, facility drawdowns, and insurance/ takaful claims, severely straining liquidity buffers. Operational risk broadens to encompass disruptions from physical damage to infrastructure and data centers, alongside the burgeoning threat of climate-related lawsuits targeting financial institutions for inadequate risk management and disclosure, and potential reputational damage from evolving consumer preferences for climate-friendly practices. Finally, Insurance/Takaful underwriting risk faces a dual challenge: a surge in insured/covered losses due to more frequent and intense natural catastrophes, increasing weather-related claims; and a widening insured/covered gap as limited underwriting capacity struggles to meet rising physical risks while remaining constrained by customer willingness to pay.

These interconnected risk transmissions underscore the imperative for innovative solutions within Islamic Green Finance, where Takaful, with its principles of mutual assistance and shared responsibility, offers a compelling framework for collective risk mitigation and resilience building in the face of climate change.

As delineated by Bank Negara Malaysia (BNM, 2025) in Figure 1, the Climate Risk Management Cycle offers a meticulously structured framework indispensable for financial institutions navigating climate-related risks. The cycle encompasses four key stages: Identification, Measurement, Monitoring, and Control, each playing a vital role in mitigating the impact of climate change on financial stability. The identification phase involves recognizing high-risk sectors and customers based on carbon intensity, geography, or business strategy. Measurement assesses these exposures through top-down or bottom-up approaches, evaluating financial implications on profitability, investment, and claims. The monitoring phase ensures regular updates to management using key metrics like greenhouse gas (GHG) emissions and exposure to transition risks. Finally, the control phase nurtures climate resilience by promoting sustainable practices and embedding risk into pricing mechanisms. Integrating robust risk frameworks into Islamic finance significantly bolsters both financial inclusion and resilience (Hussain et al., 2020). This strategic integration positions Takaful as a highly viable and ethically aligned solution for mitigating climate vulnerabilities (Mohd Zain et al., 2024).

Figure 1. Illustration of Climate Risk Management Cycle



Source: Bank Negara Malaysia (BNM), (2025).

4. Discussion and Analysis

4.1. Climate Change- Related Risk

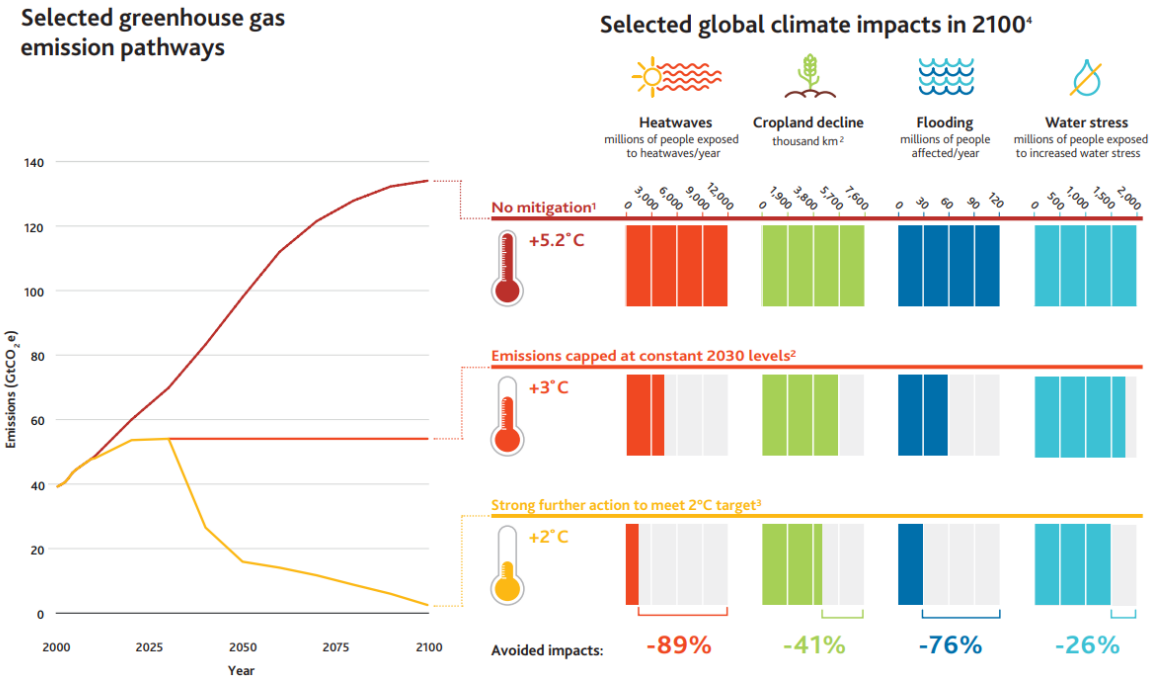
Since 2015, climate risks and other sustainability factors have increasingly dragged into the core of the financial system function, through different measures and actions. These and other developments have prompted supervisory authorities to examine climate change's relevance for insurance supervision, both individually and collaboratively through the Sustainable Insurance Forum (SIF) (IAIS, 2018). These studies have not only supported the sector which provides financial protections for individuals and businesses but also demonstrated the benefits of collaboration between different sectors to help expedite the development and convergence of best practices.

Climate-related risk is recognised as a significant emerging risk affecting many sectors, and one of many sources of structural change affecting the financial system (CFRF, 2020). It may have an impact on the resilience of individual financial institutions, including insurance/takaful sector, as well as on financial stability through physical risks and transition risks (Golnaraghi, 2022). From insurance industry's perspective, climate change is not a new risk rather it is a modifier or accelerator of existing risks. Similarly, takaful industry has traditionally been exposed to environmental-related physical climate risks such as floods, earthquakes, hurricanes, typhoons, tsunamis, volcanic eruptions, and rising sea levels, which have cascading impacts across the financial system, including on investment companies and banks, particularly where risks are not insured (IAIS, 2018). For instance, they can reduce the value of assets held by households, banks and investors, which reduces the profitability of firms, leading to a deterioration of corporate balance sheets. This can have a direct impact on the value of investments made by financial institutions and can also increase credit risk for banks if the affected assets serve as collateral for bank loans. If banks do suffer significant losses, they could restrict lending, further exacerbating the financial impact of physical risks through a reduction in credit supply (Bank of England, 2017). Therefore, financial institutions are currently deepening its activities in insurance, and initiating an internal review of the impact of climate change on Prudential Regulation Authority (PRA) regulated institutions in the world banking sector.

While physical risks arise from increased damage and losses from physical phenomena associated with both climate trends (i.e. changing weather patterns, sea level rise) and events (i.e. natural disasters, extreme weather), transition risks may be motivated by policy changes, market dynamics, technological innovation, or reputational factors. Policy and regulatory measures may affect specific classes of financial assets relevant to insurance and takaful operators' (ITOs) investment (such as real estate portfolios), in addition to those affecting capital markets as a whole.

To demonstrate this, Chart 1: Emissions Scenarios and Climate Impacts in 2100 illustrates predicted climate impacts for three scenarios: no mitigation, emissions capped at constant 2030 levels, and an emission pathway consistent with the 2°C (Bank of England, 2017). As can be seen, a no mitigation scenario results in the highest predicted increase in global temperature and most severe climate impacts. These climate impacts, such as flooding, increase the physical risks from climate change and can result in financial losses and economic disruption.

Chart 1. Emissions Scenarios and Climate Impacts in 2100



Source: Bank of England (2017)

Understanding the impacts of climate change has become a top priority and future focused ITOs will need to embed climate risk mitigation strategies into their operating and business models. Takaful operators' liability exposures will bear the brunt of riskier and unpredictable risk underwriting due to climate change and societal issues. The influence of physical climate change risk on takaful operators' underwriting, and particularly their investment decisions, is likely to grow, especially for new business lines or projects, as social and regulatory pressures push more operators to take the issue of climate change risk into account.

Takaful operators' underwriting has often come under certain regulatory requirements, for example, motor third-party liability lines (for bodily injury or property damage) and workers' compensation (for workplace injury). As legal and regulatory frameworks develop to better manage environmental and social issues, this may spur the growth of products and services that directly address these needs. For instance, growth is anticipated within the environmental pollution liability market, which remains voluntary in most markets, except China, Korea and Germany.

The general takaful business has shorter investment horizons and tends to invest mainly in highly liquid asset classes in terms of the investment horizon. In contrast, family takaful businesses are comparatively more susceptible than their general takaful peers to stakeholder pressure on their stewardship of longer duration investment portfolios. The long-term nature of investment portfolios (particularly family takaful business) exposes them to transition risk-related changes in government policies and public attitudes towards non-sustainable industries and companies. If family takaful operators do not invest wisely, they could be exposed to lower investment returns, from so-called stranded assets that may become increasingly illiquid, or investment losses.

Climate change poses varying levels of physical and transition risk to both sides of the balance sheet (liabilities and assets) for takaful operators. Therefore, the assessment of the overall risk

exposure of a takaful undertaking (TU) should take into account emerging risks arising from climate change in order to address the dependencies and interrelationships between risk categories (e.g., underwriting risk and market risk) as well as within a risk category (e.g., equity risk). This should include an assessment of potential reinforcing effects between different risk types, as well as potential "second-order effects" that is, indirect effects to a TU's exposure caused by physical risks arising from climate trends (e.g., sea-level rise) and related extreme events, and transition risks associated with the transition to a low carbon economy which may trigger among other things, new market dynamics and policy changes. The time horizon over which the risk manifests itself is a key factor and varies across the different lines of business and investments, which adds to the complexity of assessing climate risk impacts.

4.2. Opportunity Presented by Climate Change Risk

While climate change poses some risks for the takaful sector, it also presents opportunities for the sector to build resilience. Important developments have been experienced on the climate science, policy, technology, litigation and regulatory fronts, with implications for companies' efforts to assess the impacts of climate change-related risks and opportunities on their business model.

However, the increasing frequencies of high severity impact may require takaful operators to rely on state support to preserve coverage for the worse affected segments, particularly for households. We believe that 'facilitating the transition' will become a vital route for the worst affected policyholders to continue to obtain policy cover (potentially at a much higher cost of premium), to manage the potentially costly transition to a low carbon economy.

It is important to recognise that takaful operators, within their role as risk managers, risk carriers and risk investors, may be well versed in understanding the dynamics of such extreme events, and may be able to adjust exposures through annual contract repricing. Fortunately, the sector is well placed to build resilience against the impacts of climate change and support the transition to a low carbon economy. Moreover, given their expertise in risk assessment, takaful operators are well positioned to produce meaningful and decision useful information that is already deeply embedded in undertakings' risk management, underwriting and investment processes.

Beyond losses from physical climate loss events, climate trends and shocks can pose economic disruptions affecting takaful operators', the economy, and the wider financial system. The "protection gap" for weather-related losses remains significant, resulting in a significant burden on households, businesses, and governments (Network for Greening the Financial System, 2018).

It may be highlighted that takaful operators' decision making on climate change issues will be steered by risk appetite defined at the governing board and delegated board levels, which will be subject to change over time as internal knowledge and experience grow. This will include a discussion of which climate change issues are most material across the lines of business from either a financial or regulatory/supervisory perspective, or whether stakeholders are raising specific climate change-related issues that may result in reputational or ethical risks. For instance, unlike banking, the role of the sector as a risk carrier can hardly or often readily be substituted or replaced by any other institution which can sometimes be substituted by accessing capital markets. The lack of shipping coverage, and plant or equipment cover can often make certain business activities economically unviable. The lack of substitutability is indicative of the pressure that the sector can exert on industry sectors, which other financial services providers are less well placed to do.

ITOs' stewardship activities on investment portfolios are likely to remain of greater importance than their investment in labelled financial instruments, such as green and social sukuk, even though the focus of impact investing is turning towards generating a positive climate change impact

alongside the more popular environmental or "green" benefit. There is increasing demand for more innovative parametric or index-based cover that may complement existing catastrophe insurance, particularly for weather-related events. For instance, Modelling for weather-related perils can be enhanced through the provision of improved datasets such as Synthetic Aperture Radar data from satellites, which can peer through cloud cover to collect near real time insights on the potential consequences of flood events. This allows takaful operators to assess the potential impact of a flood on their portfolio within 24 hours of the water's peak. In turn, this can enhance underwriting's reserving and claims handling process with a faster response time.

4.3. Management of Climate Change Risk

Identifying and evaluating risks, as well as offering protection against them, is at the heart of the takaful business. Accordingly, it is not surprising that takaful operators' strategy on climate change risk is primarily focused on risk management. Managing and limiting these costs demands a much broader awareness and understanding of the risks.

SwissRe data shows that insured losses and perils are increasing across regions by 5-7% each year. Businesses, for example, need to take a long-term perspective on their risk and not rely solely on experience or historic data to inform future strategy. More strategic use of data can improve modelling and help the public and private sectors better understand where risks lie. This will also help close the protection gap, ensuring the right cover is sought and accurate costs are reflected in premiums.

Accurately pricing climate risk is crucial for business and financial institutions to effectively navigate the challenges posed by climate change. It supports proactive risk management, assists other financial market participants to better understand/value the risks taken and drives the transition to a more resilient and environmentally conscious economy.

Although many takaful operators have always included factors such as extreme weather events and people's health in risk analysis, stress test and scenario analysis. These tools are increasingly deployed by operators and regulatory authorities to consider plausible representations of what might happen to liability risks, and, particularly for family takaful business lines, their investments, under more extreme environmental risks linked to climate-change scenarios. The scenarios used are based on different future paths of climate policies, technological developments and consumer behaviour, which aim at limiting the rise in global temperatures, typically over a long-time horizon (e.g. over 30 years).

The latest science on climate change mitigation and adaptation, updating climate change scenarios and stressing the need for more immediate and large-scale reductions of greenhouse gas (GHG) emissions to meet the Paris Agreement (CarbonBrief, 2022). On the other hand, discussions at COP26 pointed to a number of large-scale public and private sector alliances already working to accelerate the development and scale-up of new climate technologies for decarbonising major GHG emitting sectors.

Climate change scenario analysis methodologies are a developing discipline. Given uncertainties surrounding the modelling of climate outcomes, such techniques are likely to be more useful in supporting discussions among operators and their regulators, on their climate risk strategy. Results from future tests will also be useful in meeting the growing stakeholder demands for insurers to disclose vulnerabilities to climate change risks. Some regulators (French) in 2021 piloted a climate stress test projected that large insurers' vulnerabilities from physical risk events could lead to the cost of claims rising over 30 years by a factor of five or six. However, total investment losses linked to transition related risks were projected at just 3% of participating insurers' French financial assets

by end 2050 under the harshest scenario (Fitch Ratings, 2021).

The Bank of England's pilot climate stress test results in May 2022, which utilises harsher assumptions than the earlier French climate test, projected that life insurers' equity and long-duration corporate bond portfolios would account for the majority of projected investment losses of about 15% of total market value. Non-life insurers were projected to face much higher physical risks, with estimated increases in annual losses from UK liabilities up to four times higher than firms' own projections (Fitch Ratings, 2022).

Mandatory regulatory requirements for climate change risk disclosure are imminent. Furthermore, following the COP26 announcement by the International Financial Reporting Standards (IFRS) Foundation about the establishment of its International Sustainability Standards Board (ISSB), the development of global baseline standards for sustainability reporting, with a focus on climate change, is underway (The Geneva Association, 2022).

According to Bank Negara Malaysia (2022), the primary concern of ITOs in relation to climate-related risks would be the concentration of their insured/covered risks to geographical areas that are prone to natural calamities. Several ITOs have in place tools to identify and monitor the concentration of portfolio in areas susceptible to climate-related risks and enable the ITOs to take prompt corrective actions to reduce any adverse financial impact arising from increased claims that have to be paid out.

5. Conclusion

Physical, transition and liability risks arising from climate change affect the success of sustainable projects of households, businesses, and governments; and put significant burden on ITOs' business risk profile, underwriting strategy and underwriting processes. ITOs help mitigate these risks by providing the community with fair coverage and financial protection. Over the past 20 years, ITOs have developed more sophisticated approaches to modelling risks from catastrophes and other weather-related events, where the climate-related risks within underwriting risk is likely to be dependent on various elements (e.g., duration of the contract, frequency and severity of climate events, localisation of the goods and persons covered, impact of perils on their policies, reinsurance agreements, terms and conditions). It confirms that ITOs as solution to climate changed risks and ITOs operate on cooperation and shared responsibility, safeguarding investments in Islamic green finance and promoting stability in the industry.

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