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Sustainability, Climate Risks and Green Insurance Products: An Integrated Framework Analysis

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Abstract

The insurance sector, as one of the most critical institutions of the global financial system, is at the forefront of playing an effective role against the effects that increase the impact of climate change. This study presents a comprehensive, general framework addressing the principles of sustainability, climate-related risks, and the effects of the emergence of green insurance products. The UNEP-FI Sustainable Insurance Principles (PSI), drawing on national and international sustainability standards, primarily the Paris Agreement and the latest IPCC assessment reports, prepare a role map for how the insurance sector is adapting to the rapidly changing risk landscape. It argues that climate change not only challenges traditional actuarial models based solely on historical claims data but also creates structural incentives for innovation in product design. Green insurance products, highlighting renewable energy companies, green buildings (LEED certified), organic farming, low-carbon transportation, environmental pollution liability, and wildfire protection, are identified as key tools for aligning the sector with the global net-zero transition agenda. The role of major reinsurers—Swiss Re and Munich Re—in guiding climate-resilient solutions is critically evaluated. Furthermore, Turkey's 2053 Net-Zero Emissions Target and long-term climate change strategy are examined as a regional case study. The findings are as follows: This demonstrates that scaling up green insurance penetration, strengthening public-private partnerships, and incorporating ESG criteria as a measure of insurance value are essential for both financial resilience and achieving sustainable development goals.

Keywords: Climate change, sustainability, green insurance, natural disaster, risk management, ESG, net zero, reinsurance
Jel codes: G22, Q54

1. Introduction

Climate change has emerged as a systemic risk of our time, threatening the economic, social, and environmental foundations established by the world's nations. Its consequences, such as increasing natural disasters, rising sea levels, prolonged droughts, and extreme weather events, place heavy financial burdens on households, corporations, and governments worldwide. In this context, the insurance sector occupies a structurally critical position: it possesses the capacity to offer risk transfer mechanisms that ensure economic recovery and resilience, while also considering the losses resulting from climate change. Traditional actuarial models, relying on past claims data to predict potential future events, are becoming increasingly inadequate in an era where

climate change is weakening the predictive validity of these models. Therefore, insurers are forced to re-evaluate their policy-making criteria, premium-setting methods, and portfolio strategies. Simultaneously, increasing regulatory and market pressure to align financial intermediaries with environmental, social, and governance (ESG) standards presents both challenges and opportunities for the sector. This study addresses three interconnected objectives. Firstly, it offers a conceptual overview of climate change and its impact on the insurance sector. Secondly, it examines the global and sector-specific policy frameworks that define the social environment in which insurers operate. Thirdly, it analyzes the evolving diversity of green insurance products and evaluates the strategic behavior of major reinsurance companies, particularly SwissRe and MunichRe.

2. Climate Change as a Source of Risk fort he Insurance Sector

2.1. The Science and Scope of Climate Change

Climate is defined as the long-term statistical distribution of atmospheric conditions in a given region and is a process that is very well-tracked and undergoes rapid change. The average global temperature has increased by approximately 1.1°C compared to the pre-industrial era (1850-1900), primarily due to fossil fuel use, land-use change, and greenhouse gas emissions from industry. As a result of continued policy implementation, the IPCC's Sixth Assessment Report predicts a warming of up to 3°C by 2100. If this level is reached, it is estimated that an irreversible critical threshold will be crossed in the Earth's ecosystem. This is expected to negatively impact the insurance sector. The numerical increase and severity of disasters caused by adverse weather events such as hurricanes, floods, droughts, wildfires, and hailstorms make predictions based on standard risk models difficult. In 2020, insured losses worldwide from natural disasters reached US$97 billion, the vast majority of which were due to the effects of climate change. By 2023, insured natural disaster losses reached US$117 billion, almost double the 30-year average; this is interpreted as an indicator of the rapid transformation and rapid expansion of the impact of climate change.

2.2. Affected Insurance Branches

Climate change affects all branches of insurance. Fire and personal accident insurance types are directly exposed to physical damage due to warming and rapidly changing weather conditions. Agricultural insurance appears to face increased risks due to droughts, sudden floods, and changing seasonal patterns. Health and life insurance is exposed to indirect risks due to deaths from extreme temperatures, the spread of infectious diseases, and food insecurity. Insurance types related to maritime, engineering, and transportation, which are part of the logistics sector, are affected by infrastructure problems and changes in trade routes due to rising sea levels and melting ice in polar regions. The layered nature of these risks demonstrates that climate risk cannot be managed within national, regional, and sectoral boundaries.

2.3. The Protection Gap Problem

One of the critical problems facing the global insurance sector is the 'protection gap': defined as the difference between the total economic losses resulting from natural disasters and the portion covered by the insurance sector. In 2023, approximately 35% of the losses incurred in the Turkey-Syria earthquake disaster centered in Kahramanmaraş were uninsured. This protection gap is particularly pronounced in middle and low-income countries where insurance awareness is not well-established, and in regions where markets are declining in the face of new hazards such as coastal floods and forest fires. Reducing the protection gap requires innovative product design as well as supportive public policies, including state-supported disaster insurance programs similar to Türkiye's DASK model.

3. Global Governance and Sectorel Policy Frameworks

3.1. International Climate Agreements

The international response to climate change is based on a multilateral agreement architecture that has been developing for over thirty years. The UNFCCC, adopted in 1992 and entered into force in 1994, established the fundamental principle of preventing "hazardous human-induced interventions" in the climate system. The 1997 Kyoto Protocol introduced binding emission reduction commitments for developed countries and implemented market-based mechanisms such as carbon trading. The 2015 Paris Agreement, which entered into force in November 2016, created a paradigm shift by establishing the National Contribution Declarations (NDC) system; it creates a universal regime aimed at limiting the global temperature increase well below pre-industrial levels, preferably 1.5°C. As of 2023, 195 Parties have ratified the Agreement; 153 Parties have submitted updated or revised National Contribution Declarations (NDCs).

3.2. Sector-Specific Mitigation Measures

Insurance regulators and industry organisations have responded to the climate problem with various measures. These include the development of risk atlases and disaster models that include non-stationary climate projections; Mandatory climate risk disclosure requirements in line with the recommendations of the Task Force on Financial Climate Disclosures (TCFD); and the integration of ESG criteria into policy writing and investment guidelines are included. These developments are transforming climate from a reputational concern to a fundamental issue for solutions and strategic management.

4. Sustainable Insurance: Principles and Financing Mechanisms

4.1. UNEP-FI Sustainable Insurance Principles

The United Nations Environment Programme Finance Initiative (UNEP-FI) launched theSustainable Insurance Principles (PSI) in 2012 as the largest collaborative initiative betweenthe UN and the insurance industry. The PSI framework rests on four core commitments: (i)implementing ESG assessments throughout the entire insurance value chain, including policywriting and claims management; (ii) working with clients, partners and intermediaries to raiseawareness and develop risk management solutions; (iii) collaborating with governments,regulators and other stakeholders to encourage systemic responses; (iv) demonstratingaccountability and transparency through regular public reporting on PSI implementation.

4.2 Green Finance and Insurance

Green finance is defined as investing capital in activities that consider environmental benefits or reduce environmental harm. Green insurance, a subset of green finance, operates as a dual function; providing financial protection against climate change-related losses and simultaneously promoting the adoption of green finance products derived from green technologies and practices by offering preferential terms or guarantees not normally available under existing policies. The Cambridge Institute for Sustainable Leadership (CISL) has identified nine policy strategies that the insurance industry can use to combat climate change.

4.3 Innovative Insurance Policy for Climate Risk Mitigation

Beyond product-level innovations, systematic changes in insurance policies are needed to mitigate and measure the effects of climate change. Recommended measures include dynamic pricing models based on rewards for those adopting and implementing risk-reducing policies, and the expansion of parametric insurance mechanisms based on objective climate indices (such as rainfall levels and wind speeds). Furthermore, ecosystem-based strategies that utilize natural systems to mitigate risk and provide payments in the event of a disaster are also recommended.

5. Green Insurance Products: A Taxonomic Analysis

5.1. Conceptual Framework

Green insurance products are generally examined in two categories: (i) products where pricing or coverage terms create direct financial incentives for environmentally friendly practices; (ii) insurance products designed to scale the risks posed by climate change, tailored to the risks associated with investments, green technologies, and activities. Both product types contribute to reducing barriers to green finance products and aligning the risks involved with societal climate goals.

5.2 Key Product Categories

Green Building Insurance covers buildings certified under internationally recognized environmental standards such as LEED or BREEAM. These insurance products include "green upgrade" clauses that cover existing repairs in the event of damage and commit to a better environmental standard than the one before the damage. Renewable Energy Insurance covers the entire lifecycle of solar, wind, geothermal, and other clean energy facilities, from the construction phase to engineering risks, operational risks, and even income protection in contracts after completion. This segment is one of the fastest-growing areas in the green insurance product range. Organic Farming Insurance financially protects certified organic farmers against yield losses caused by adverse weather conditions, pests, and disease outbreaks. This product also contributes to the economic sustainability of organic production systems by considering soil health, water quality, and biodiversity. Low Carbon Transportation Insurance covers electric vehicles, hybrid vehicles, and public transportation vehicles and their drivers; it supports the automotive and transportation sector in achieving its low-carbon goals through premium reductions or broader incentives. Environmental Liability Insurance (ELI) protects against the financial consequences of accidental pollution incidents, including soil contamination, groundwater contamination, and oil spills caused by companies. This insurance product is becoming increasingly important for internalizing environmental externalities and ensuring compliance with the "polluter pays" principle. Forest Fire Insurance

provides financial compensation to landowners, municipalities, and governments for losses resulting from increased fire incidents due to climate change. The increasing frequency and intensity of fires due to prolonged droughts, rising temperatures, and land management failures have made this product important in regions such as the Mediterranean, Australia, and North America.

6. The Insurance Sector's Response to Climate Change

6.1. Swiss Re's Climate Strategy

Swiss Re, the world's second-largest reinsurance company by premium volume, anticipates climate change as a central strategic risk for the coming years and is developing strategies accordingly. Its strategic framework addresses three interconnected challenges: closing the disaster protection gap, supporting the net-zero transition through renewable energy risk solutions, and enabling public-private sector climate management. Swiss Re is expanding its coverage to vulnerable populations and geographies by developing innovative risk transfer solutions, including public sector parametric schemes and public-private partnership frameworks. 6.2 Munich Re's Low Carbon Solutions Munich Re, the world's largest reinsurance company, has introduced a comprehensive portfolio of low-carbon solutions structured around five strategic pillars: (i) enabling the generation, transmission, storage, and use of renewable energy; (ii) scaling up clean and climate-neutral mobility; (iii) supporting the transition to renewable raw materials; (iv) financing the energy infrastructure necessary for full system decarbonization; (v) environmentally friendly implementation of carbon capture and use (CCU) and carbon capture and storage (CCS) technologies. Munich Re also highlighted that annual insured losses have exceeded US$100 billion for several years and stated that it expects an upward trend with roughly varying annual growth rates linked to the intensification of climate change and the increase in insured values in at-risk regions.

7. Conclusion

This article provides an integrated analysis of the relationships between sustainability, climate risk, and green insurance in the context of the accelerating global climate crisis. Several conclusions emerge from the review. First, the insurance sector faces a twofold impact from climate change: as a risk bearer assuming increased catastrophic losses and as an institutional investor exposed to the devaluation of carbon-intensive assets. Addressing both dimensions requires a shift in risk governance from reactive loss compensation to proactive risk prevention and resilience building. Secondly, the existing international governance architecture, supported by the Paris Agreement and the UNEP-FI PSI framework, provides a solid normative foundation for climate action in the insurance sector. However, effective implementation requires sustainable regulation. To achieve effective implementation, the sector needs to establish sustainable regulations, create standards for climate change risks and ensure uniformity in this area, and develop policy strategies for the actuarial and insurance sectors. Thirdly, green insurance products are seen as a strategically important tool for aligning the insurance sector with its carbon footprint reduction goals. Scaling these products requires prioritizing regulatory frameworks that facilitate both sector and customer access, government-backed incentive programs, and consumer awareness campaigns. Fourthly, the protection gap, particularly for developing markets and underdeveloped countries vulnerable to climate risk, is seen as a major challenge for the global insurance sector. Parametric solutions, public-private risk-sharing arrangements, and mandatory disaster insurance programs can help close this gap while protecting the financial standing of the actuarial sector. Fifth, Türkiye's 2053 Net Zero Target and Paris Agreement commitments are expected to drive the development of new capabilities, products, and partnerships within the local insurance sector. Priority areas include renewable energy insurance, green building insurance, agricultural climate adaptation products, and disaster risk pooling under the DASK (Turkish Natural Disaster Insurance Pool) framework.

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