



The Impact of Climate Change on Insurance Law: Redefining Risk in Natural Disaster Insurance

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ABSTRACT: Climate change, as the most fundamental global challenge of the twenty-first century, profoundly impacts insurance law. The increasing frequency and severity of natural disasters are fundamentally transforming the insurance sector's risk calculation models, coverage scope, and premium structures. This study analyzes the impact of climate change on insurance law, the necessity of redefining the concept of risk, and coverage issues in natural disaster insurance from an analytical and critical perspective. A comprehensive assessment is conducted in light of the insurance provisions of the Turkish Commercial Code (TCC), European Union regulations (Solvency II, EIOPA guidelines), international reports (IPCC, Swiss Re sigma, Munich Re NatCatSERVICE), and comparative law data. The study employs a dogmatic legal method combined with comparative law methodology. State-backed disaster insurance models (DASK, Flood Re, Cat Nat, NFIP) are compared, and a new liability and coverage model aligned with climate change adaptation is proposed. The findings reveal that traditional actuarial models based on historical data are increasingly inadequate, the insurability of certain climate risks is under threat, and comprehensive legislative reforms—particularly the expansion of Turkey's DASK model to cover climate-related disasters—are urgently needed.

KEY WORDS: Climate change, insurance law, natural disaster insurance, risk, DASK, Solvency II, insurability, premium, coverage.

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I. INTRODUCTION

Climate change is the defining issue of the twenty-first century, profoundly affecting economic, social, and legal structures on a global scale. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report demonstrates that the global mean temperature has increased by 1.1°C compared to pre-industrial levels, significantly intensifying the frequency and severity of natural disasters [1]. According to the Swiss Re Institute's sigma reports, global insured losses from natural catastrophes reached USD 108 billion in 2023, exceeding the ten-year average [2]. In 2024, this figure rose to USD 137 billion, marking one of the costliest years on record for the global insurance industry [3]. These escalating figures underscore the urgency of addressing climate-related risks within insurance law frameworks.

The insurance sector constitutes one of the areas most directly and indirectly affected by climate change. The increasing frequency of natural disasters raises insurers' claims payments, challenges the validity of traditional actuarial models, and threatens the insurability of certain risks [4]. Munich Re's natural catastrophe data indicate that climate-related disasters have doubled economic losses over the past thirty years [5]. This trend has significant implications not only for the financial stability of insurance companies but also for the broader goal of maintaining affordable and accessible insurance coverage for individuals and businesses.

The purpose of this study is to analyze the impact of climate change on insurance law, with particular emphasis on the need to redefine the concept of risk in natural disaster insurance, from both Turkish law and comparative law perspectives. The study employs the dogmatic legal method and comparative law methodology in combination. The insurance provisions of the Turkish Commercial Code (TCC), EU regulations, IPCC and Swiss Re data, and the DASK (Turkish Catastrophe Insurance Pool) application

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constitute the primary reference sources. The study addresses three interconnected research questions: first, how climate change necessitates a conceptual transformation of risk in insurance law; second, what lessons can be drawn from international disaster insurance models; and third, what legislative reforms are required to adapt Turkish insurance law to climate realities.

II. MATERIALS AND METHODS

This study employs a dual-method approach combining dogmatic legal analysis with comparative law methodology. The dogmatic legal method is used to systematically examine the existing provisions of the Turkish Commercial Code (TCC, Law No. 6102), particularly Articles 1401–1520 governing insurance contracts, and to assess their adequacy in addressing climate-related risks. This includes a detailed doctrinal analysis of the concepts of risk (Article 1401), aggravation of risk (Article 1444), pre-contractual disclosure obligations (Article 1435), and the insurer's duty to inform (Article 1421). Legislative texts, scholarly commentary, and doctrinal interpretations from leading Turkish insurance law scholars are examined to identify gaps and tensions in the existing legal framework when confronted with the systemic nature of climate-driven risk.

The comparative law methodology is employed to analyze state-backed disaster insurance models from four jurisdictions: Turkey (DASK), France (Cat Nat), the United Kingdom (Flood Re), and the United States (NFIP). These jurisdictions were selected based on the diversity of their institutional designs—ranging from fully public to hybrid public-private models—and the availability of comprehensive legal and empirical data. The comparative analysis evaluates each model against the five-element framework established in OECD reports: compulsory participation, risk-based pricing, government reinsurance, loss mitigation incentives, and data infrastructure.

Primary sources include legislative texts (TCC, Law No. 6305, Solvency II Directive), regulatory guidance (EIOPA opinions, TCFD recommendations), and institutional reports (IPCC AR6, Swiss Re sigma, Munich Re NatCatSERVICE, Geneva Association, Lloyd's, OECD). Secondary sources include monographs, peer-reviewed journal articles, and conference papers from Turkish, European, and American insurance law scholarship. All Turkish-language sources are cited in their original form to preserve doctrinal precision, while their key arguments are presented in English within the text. Data on insured losses, penetration rates, and premium trends are drawn from industry reports and are used to contextualize the legal analysis rather than as the basis for independent empirical claims.

III. CLIMATE CHANGE AND INCREASING NATURAL DISASTER RISKS

A. The Impact of Climate Change on Natural Disasters

The Working Group II component of the IPCC Sixth Assessment Report scientifically establishes that climate change increases the severity and frequency of natural disasters including floods, storms, droughts, wildfires, and sea-level rise [6]. Should the 1.5°C target envisaged in the Paris Climate Agreement be exceeded, these impacts are projected to grow exponentially [7]. The report further highlights that compound and cascading climate events—where multiple hazards occur simultaneously or sequentially—present unprecedented challenges for risk modeling and insurance coverage design.

According to Swiss Re Institute data, global insured losses from natural catastrophes have been increasing at a real annual average rate of five to seven percent, approximately twice the rate of global GDP growth. In 2024, hurricanes in the United States (Helene and Milton), severe storms, and flood disasters worldwide caused total insured losses of USD 137 billion. The disproportionate concentration of these losses in specific geographic regions raises fundamental questions about the equitable distribution of climate risk and the capacity of traditional risk pooling mechanisms to absorb such concentrated exposures.

B. Transformation of Risk Calculation Models in the Insurance Sector

Traditional actuarial models are based on statistical analyses of historical data, relying on the fundamental assumption that past loss patterns provide a reliable basis for predicting future outcomes. However, the “new normal” created by climate change undermines the capacity of historical data to predict the future [8]. As emphasized in Mills' pioneering study published in *Science*, climate change is forcing the insurance sector toward an “insurance in a changing climate” paradigm. This paradigm shift requires a fundamental reconsideration of how risk is identified, measured, and priced within the insurance contract.

Climate scenario analysis necessitates forward-looking risk assessment in place of traditional retrospective models. EIOPA has recommended that insurance companies incorporate climate change risk scenarios into their Own Risk and Solvency Assessment (ORSA) processes [9]. The Network for Greening the Financial System (NGFS) has developed climate scenarios for central banks and supervisory authorities, providing a standardized framework for assessing the financial implications of various climate pathways [10]. These developments signal a regulatory expectation that insurers move beyond purely historical data and integrate prospective climate modeling into their underwriting and pricing decisions.

C. New Risk Policies of Insurance Companies

In the face of risks intensified by climate change, insurance companies pursue three fundamental strategies: first, increasing premiums to reflect the heightened risk exposure; second, narrowing coverage scope or adding exclusions for specific climate-related perils; and third, withdrawing entirely from certain regions or risk categories that are deemed uninsurable [11]. The decision

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by some insurers in high-risk U.S. states such as California and Florida to cease writing new policies represents the most striking example of this trend, leaving millions of property owners without access to private market insurance coverage.

Lloyd's of London's protection gap report reveals that a significant portion of natural disaster losses worldwide remains uninsured [12]. This protection gap leads to serious social inequities, particularly in developing countries and low-income communities [13]. The widening gap between economic and insured losses represents not only a market failure but also a significant policy challenge, as uninsured populations become dependent on post-disaster government aid, which is often insufficient and untimely. This dynamic creates a negative feedback loop where the most vulnerable populations bear the greatest financial burden of climate change.

IV. TRANSFORMATION OF THE CONCEPT OF RISK IN INSURANCE CONTRACTS

A. The Concept of Risk in Insurance Law

Risk (riziko) is the constitutive element of the insurance contract and lies at the center of the definition of insurance contracts under Article 1401 of the TCC [14]. Kender aptly defines risk as “a danger threatening a monetarily measurable interest of the policyholder or the insured” [15]. Ünan characterizes risk as “an uncertain event constituting the object of insurance protection, the occurrence of which gives rise to the insurer's obligation to perform” [16]. These definitions share a common emphasis on uncertainty as the defining feature of insurable risk—an element that climate change is fundamentally altering.

One of the fundamental principles of insurance law is that risk must be determinable and calculable. The law of large numbers ensures that individual risk costs become predictable when a large number of similar risks are pooled together [17]. However, climate change seriously undermines this predictability in several critical ways. The assumption underlying traditional actuarial models—that past data represents the future—is losing its validity in the face of the systemic transformation caused by climate change [18]. Furthermore, the spatial correlation of climate risks—where a single event such as a hurricane or flood affects numerous policyholders simultaneously—challenges the diversification assumptions that underpin the law of large numbers. This correlation risk means that insurers face the possibility of massive, concentrated losses that cannot be adequately diversified through traditional portfolio management techniques.

B. Impact of Natural Disaster Risks on the Contract

Article 1444 of the TCC regulates the aggravation of risk (rizikonun ağırlaşması), stipulating the policyholder's obligation to notify the insurer of significant changes relating to the risk [19]. In the context of climate change, the aggravation of risk is no longer an individual and instantaneous event but has become a systematic and gradual process. A region's flood risk profile may structurally change over decades due to climate change, rendering the original risk assessment obsolete well before the policy term expires [20]. This situation raises a critical conceptual question in insurance contract law: should the gradual risk increase caused by climate change be characterized as “aggravation of risk” within the meaning of TCC Article 1444? Or is this change a macro trend that should have been factored in at the inception of the contract? [21]. As Ayhan, Çağlar, and Özdamar aptly observe, this question constitutes one of the most current areas of debate in insurance law [22]. The answer to this question has profound practical implications: if climate change is treated as an aggravation of risk, the policyholder bears the burden of disclosure; if it is treated as a foreseeable macro trend, the insurer bears the burden of incorporating it into the original risk assessment and pricing.

C. The Insurer's Risk Assessment Obligation

Article 1435 of the TCC regulates the policyholder's pre-contractual duty of disclosure [23]. However, in the context of climate change, the center of gravity of the risk assessment obligation is shifting from the policyholder to the insurer. In modern insurance law, the insurer has access to sophisticated risk modeling tools, satellite imagery, geographic information systems, and big data analytics [24]. The informational asymmetry that historically justified placing the disclosure burden on the policyholder is increasingly reversed when it comes to climate risk assessment.

The TCFD (Task Force on Climate-Related Financial Disclosures) recommendations require insurance companies to integrate climate risks into their financial reporting [25]. This regulatory development implicitly recognizes that insurers possess—or should possess—superior knowledge of climate risks compared to individual policyholders. The question then arises whether a duty of good faith requires insurers to share their climate risk assessments with policyholders and to adjust premiums and coverage terms proactively rather than reactively.

V. COVERAGE ISSUES IN NATURAL DISASTER INSURANCE

A. The Debate on Narrowing Coverage Scope

The tendency of insurance companies to narrow coverage scope in the face of risks intensified by climate change creates tension with the fundamental principles of insurance law [26]. As Omağ aptly notes, the principle of protecting policyholders in private insurance law sets the limits of contractual freedom. The disclosure obligation under TCC Article 1421 requires that coverage restrictions be clearly communicated to the policyholder [27]. When coverage exclusions for climate-related events become so extensive that the insurance product provides only nominal protection, the fundamental purpose of the insurance contract—risk transfer—is effectively defeated.

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A related concern is the use of sub-limits and high deductibles for climate-related perils, which, while technically maintaining coverage, significantly reduce the effective protection available to the policyholder. These practices raise questions about the adequacy of current transparency requirements and whether additional regulatory safeguards are needed to ensure that insurance products genuinely fulfill their protective function in the context of escalating climate risks.

B. Premium Increases and the Insurability Problem

The most direct impact of climate change on the insurance sector is the increase in premiums. According to Swiss Re data, insurance premiums have increased significantly in regions with high natural disaster risk over the past five years. As Ayli demonstrates in her monograph on premium payment obligations, the balance between premium and risk is a fundamental element of the insurance contract [28]. When premiums rise to levels that are unaffordable for a substantial portion of the population, the social function of insurance—spreading risk across a broad pool of participants—is undermined.

The insurability problem represents the most fundamental challenge that climate change poses to insurance law. As emphasized in Dlugolecki's study in the Geneva Papers, insuring certain climate risks through traditional insurance mechanisms is becoming increasingly difficult. Botzen's comprehensive monograph analyzes the conditions under which extreme climate risks can be managed through insurance and identifies the theoretical boundaries of insurability. These boundaries are being tested as climate change transforms what were once considered rare, tail-risk events into recurring, high-frequency losses.

C. Risk Management Policies of Insurance Companies

As demonstrated in the Geneva Association report, the insurance sector engages with climate change both as a risk manager and as an investor. The Solvency II Directive mandates that insurance companies account for natural disaster risks in their solvency requirements [29]. Insurance Europe comprehensively addresses the sector's climate change adaptation strategies [30]. The dual role of insurers—as underwriters of climate risk and as institutional investors with significant portfolios—creates both challenges and opportunities for climate adaptation. Insurers can leverage their risk expertise to incentivize climate-resilient construction and land-use practices through differential pricing, while their investment decisions can support or hinder the transition to a low-carbon economy.

VI. STATE-BACKED DISASTER INSURANCE MODELS

A. Compulsory Disaster Insurance Models

The fact that natural disaster risks push the boundaries of insurability has necessitated state intervention. The Turkish Catastrophe Insurance Pool (DASK), established following the devastating 1999 Marmara Earthquake that caused over 17,000 fatalities, represents the most significant example of the compulsory earthquake insurance model [31]. Law No. 6305 on Disaster Insurance establishes the legal framework for DASK, mandating earthquake insurance for all registered residential buildings [32].

DASK's performance during the February 6, 2023 Kahramanmaraş Earthquakes—which claimed over 50,000 lives and constituted Turkey's most devastating natural disaster in modern history—clearly revealed both the strengths and weaknesses of the system [33]. While the speed and scope of claims payments were positively evaluated, the inadequacy of coverage ceilings, low penetration rates in rural areas, and the exclusion of non-earthquake climate-related perils from the coverage scope attracted serious criticism [34]. These shortcomings highlight the need to reconceptualize DASK as a comprehensive multi-peril disaster insurance mechanism rather than a single-peril earthquake fund.

B. Public-Private Partnership Systems

As demonstrated in Paudel's comparative study, various public-private partnership-based catastrophic risk insurance models exist globally [35]. The common feature of these models is that large-scale risks—which the private insurance market cannot cover alone—are made insurable through government guarantees or reinsurance support [36]. These partnerships recognize that catastrophic risk management requires a layered approach: primary insurance handled by the private market, excess losses absorbed by government-backed reinsurance, and residual tail risk borne by the state as insurer of last resort.

OECD reports on catastrophic risk management establish that an effective disaster insurance system must incorporate five key elements: a compulsory or semi-compulsory mechanism to ensure broad participation and avoid adverse selection; risk-based pricing to incentivize risk reduction; government reinsurance support to provide capacity for extreme events; loss mitigation incentives to encourage preventive investment; and comprehensive data infrastructure to enable accurate risk assessment [37]. The absence of any one of these elements compromises the effectiveness and sustainability of the overall system.

C. International Practices

France's Cat Nat system is a model that has been in operation since 1982, automatically adding natural disaster coverage to all property insurance policies through a fixed surcharge [38]. This universal, mandatory approach ensures very high penetration rates and avoids adverse selection, though it has been criticized for providing insufficient incentives for risk reduction. Spain's Consorcio de Compensación de Seguros model functions as a state-backed compensation fund covering both natural disasters and extraordinary risks, offering a unique hybrid approach that combines elements of public insurance and private market mechanisms [39].

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The United Kingdom's Flood Re model is a reinsurance mechanism established in 2016, aiming to provide affordable insurance for residential properties in high flood-risk areas through a cross-subsidy from lower-risk properties [40]. Notably, Flood Re includes a built-in transition mechanism, with a planned sunset clause in 2039, designed to gradually shift flood risk back to the private market as climate adaptation measures take effect. The United States' National Flood Insurance Program (NFIP) is a federally managed compulsory flood insurance system that has faced chronic financial challenges, accumulating tens of billions of dollars in debt to the U.S. Treasury [41]. Kunreuther and Michel-Kerjan's comprehensive study provides a detailed analysis of the strengths and weaknesses of the U.S. catastrophic risk management system, highlighting the tension between affordability objectives and actuarial soundness [42].

VII. COMPARATIVE LAW ANALYSIS

A. European Union Practices

The EU addresses the impact of climate change on the insurance sector through a multidimensional regulatory framework. The Solvency II Directive mandates that insurance companies account for natural disaster risks in their capital adequacy requirements, ensuring that insurers maintain sufficient financial buffers to absorb climate-related losses. EIOPA's 2021 opinion emphasizes that insurance companies should incorporate climate change scenarios into their ORSA processes, effectively requiring forward-looking climate risk assessment as part of prudential supervision.

The European Commission's 2023 protection gap communication contains policy proposals aimed at closing the natural disaster insurance protection gap in member states, including recommendations for enhanced data sharing, risk-based pricing incentives, and closer coordination between insurance supervision and climate adaptation policy [43]. The PEICL (Principles of European Insurance Contract Law) framework also addresses the contractual dimension of climate risks within the context of harmonizing insurance contracts across member states [44]. These developments collectively signal a move toward a more integrated European approach to climate risk insurance.

B. The U.S. Natural Disaster Insurance System

In the United States, natural disaster insurance is managed through different mechanisms at the federal and state levels, creating a complex patchwork of programs with varying coverage rules and eligibility criteria. While the NFIP provides compulsory insurance for flood risk at the federal level, California's FAIR Plan functions as an insurer of last resort for fire risk [45]. However, these systems are under serious financial pressure in the face of risks intensified by climate change. The NFIP's accumulated debt and the FAIR Plan's exploding exposure illustrate the limitations of existing public backstop mechanisms when confronted with systematic increases in climate risk.

C. Current Status of Turkish Insurance Law

Turkish insurance law does not contain comprehensive regulation specific to climate change. The insurance provisions of the TCC (Articles 1401–1520) provide a general framework but do not directly address the impact of climate risks on insurance contracts [46]. The DASK system is earthquake-focused, and climate-related disasters such as floods, storms, and wildfires remain outside its scope, leaving a significant gap in Turkey's disaster insurance architecture.

As demonstrated in Demirbilek and Aydemir's study, comprehensive reform is required for the adaptation of the Turkish insurance system to climate change [47]. Hokka, Durgut, and Bozkurt's research shows that the Turkish insurance sector's awareness of climate change is not yet at a sufficient level [48]. Data from the Insurance Association of Turkey confirm that the natural disaster insurance penetration rate is low compared to developed countries [49]. The combination of low insurance penetration, limited climate awareness within the industry, and the absence of a comprehensive regulatory framework for climate-related insurance makes Turkey particularly vulnerable to the financial shocks associated with climate-induced natural disasters.

VIII. DISCUSSION: LEGAL ASSESSMENT AND REFORM PROPOSALS

A. A New Risk Model for Insurance Contracts

The impact of climate change on insurance law necessitates the redefinition of the concept of risk. The transition from a traditional static understanding of risk to a dynamic one will transform the fundamental structure of insurance contracts. This transformation requires the reinterpretation of the aggravation of risk provisions under TCC Article 1444 in the context of climate change. Specifically, a legislative amendment should clarify that systemic, climate-driven risk increases are to be addressed through periodic premium adjustment mechanisms rather than through the policyholder notification regime designed for individual risk changes.

The proposed new risk model should incorporate the following elements: forward-looking, climate scenario-based risk assessment aligned with IPCC projection pathways; a periodic risk update mechanism requiring insurers to reassess and communicate risk levels at defined intervals; integration of standardized climate data (including NGFS scenarios) into insurance contract terms and pricing; and transparent risk communication ensuring that policyholders understand the climate dimensions of their coverage. As Atamer emphasizes in her analysis of indemnity insurance, the modernization of Turkish insurance law must be aligned with international developments to maintain the competitiveness and effectiveness of the Turkish insurance market.

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B. Climate Change-Adapted Insurance Systems

Expanding the scope of the DASK model to include climate-related disasters beyond earthquakes constitutes the highest-priority reform proposal. As emphasized in Surminski and Oramas-Dorta's study, flood insurance programs are an integral part of climate adaptation. The French Cat Nat and UK Flood Re models offer reference frameworks for this expansion, each with distinct advantages: the Cat Nat model's universal coverage ensures equity, while the Flood Re model's transition mechanism ensures long-term market sustainability.

The OECD's report on the financial management of flood risk demonstrates that an effective climate-adapted insurance system must combine risk-based pricing, loss mitigation incentives, and government reinsurance support [50]. Bruggeman's comparative analysis argues for the integration of legal and economic approaches in compensating catastrophic losses. For Turkey, a phased approach is recommended: in the short term, adding flood and storm coverage to the existing DASK framework; in the medium term, developing a comprehensive multi-peril disaster insurance program with risk-based pricing; and in the long term, establishing a climate-resilient insurance ecosystem linked to national adaptation policies.

C. Protection of Policyholders

The insurability problem created by climate change ultimately becomes a matter of policyholder protection. The risk that premium increases may leave low-income segments uninsured must be addressed from a social justice perspective. As Yazıcıoğlu and Şeker Öğüz emphasize in their insurance law study, the principle of policyholder protection constitutes the foundation of the TCC's mandatory provisions. Climate change risks creating a two-tier insurance system where affluent individuals and communities maintain coverage while vulnerable populations are priced out of the market, exacerbating existing inequalities.

The IPCC's 2023 Synthesis Report explicitly emphasizes that the financial dimension of climate change adaptation must be integrated with the insurance sector [51]. The strengthening of the loss and damage mechanism within the UNFCCC framework will enhance the role of insurance mechanisms in achieving climate justice at the international level [52]. Domestically, means-tested premium subsidies, mandatory minimum coverage standards, and insurer-of-last-resort mechanisms should be explored as tools to ensure that climate change does not erode the universal accessibility of essential insurance protection.

IX. CONCLUSION

Climate change is profoundly transforming the fundamental concepts, principles, and institutions of insurance law. The key findings of this study can be summarized as follows: First, the increasing frequency and severity of natural disasters necessitate the redefinition of the traditional concept of risk in insurance law; the shift from static to dynamic risk models is not merely a technical adjustment but a conceptual transformation with far-reaching legal implications. Second, the aggravation of risk (TCC Article 1444) in the context of climate change is transforming from an individual into a systematic phenomenon, revealing the inadequacy of the current legal framework to address gradual, climate-driven risk escalation. Third, state-backed disaster insurance models are indispensable for managing catastrophic risks that the private insurance market cannot cover alone, and international experience demonstrates that effective models combine compulsory participation, risk-based pricing, and government reinsurance.

From the perspective of Turkish insurance law, the most urgent reform needs include: expanding the DASK model to cover climate-related disasters including floods, storms, and wildfires; adding climate change-specific provisions to the TCC's insurance rules, particularly regarding the insurer's obligation to conduct forward-looking climate risk assessment; explicitly regulating the insurer's duty to incorporate climate scenarios into underwriting and pricing; and ensuring alignment with EU regulations (Solvency II, EIOPA guidelines) to facilitate harmonization and cross-border reinsurance. Looking ahead, the insurance sector's adaptation to climate change is not merely a legal issue but a fundamental condition for societal resilience and economic sustainability. The choices made in reforming insurance law today will determine the capacity of communities to recover from climate disasters tomorrow.

DISCLOSURE

The author reports no conflicts of interest in this work.

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