CLIMATE CHANGE? L'ADDITION, S'IL VOUS PLAÎT! A COMPARATIVE LAW AND ECONOMICS PERSPECTIVE ON THE CALCULATION OF DAMAGES

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Abstract

The number of climate change lawsuits brought before domestic, regional and international courts is growing at an unprecedented pace. Most of them have been filed to claim monetary compensation for the damage caused by public and private actors in contributing to the global warming. Drawing on the economic theory of remedies for environmental liability, the amount of damages claimed by the plaintiffs is crucial to induce polluters to optimally invest in care and accident prevention. Yet, the calculation of climate damages has not been sufficiently investigated in the scholarship on climate change litigation. Therefore, the aim of this article is to shed a brighter light on damage calculation in climate lawsuits. Particularly, the existing practice of tort-law cases with claims for damages is analysed to see whether the assessment of climate damages in litigation reflects the state of the art in climate economics. Based on a systematic and a more attentive investigation of selected cases across the world, an interesting variety of heads of damages for climate change and related methods of assessment emerged, ranging from costs of climate adaptation to costs to re-establish carbon sinks. However, none of these approaches seems to reflect the state of the art in climate economics. This leads the author of this article to observe that tort-based climate lawsuits might fail to provide polluters with optimal deterrence incentives if damages are not assessed in such a way that their magnitude is approximately the same as the magnitude of harm caused by climate change.

1. INTRODUCTION

'*By this complaint, the City seeks to ensure that the parties who have profited from externalizing the responsibility for sea level rise, extreme precipitation events, heatwaves, other results of the changing hydrologic regime caused by increasing temperatures, and associated consequences of those physical and environmental changes, bear the costs of those impacts on the City rather than the Plaintiff, local taxpayers, residents or broader segments of the public*'.

[*Mayor & City Council of Baltimore v. BP p.l.c*., par. 12 of the Complaint]

The number of climate change lawsuits brought before domestic, regional and international courts is growing at an unprecedented pace. Most of them aimed at declaring States' and companies' failures to address climate crisis, while many have been filed also to claim damage compensation. The latter seek damages due to the role of public and private actors in contributing to the global warming. In light of these litigation trends, legal scholars largely investigated issues related to the 'an', i.e. the legal standing, and the 'quomodo', i.e. the procedures to sue for the increase in global warming. However, the topic of the 'quantum', i.e. how much it should be paid for climate change, has been overlooked either by purely legal or law and economic scholars. Just to give an example, in February 2021 the Administrative Court of Paris for the first time convicted the French State of failing to reduce global emissions and ordered to take all the necessary measures to repair the ecological damage by 31 December 2022.[1] The case is well known as 'l'Affaire du Siècle' for its expected impact on national environmental policies. However, the fact that the claimants (four NGOs, including Greenpeace) originally asked to condemn the State to pay only 1 euro as a symbolic amount of money either for moral or ecological damages did not receive sufficient attention in the doctrine. Drawing on the economic theory of remedies for environmental liability, the amount of damages claimed by the plaintiffs is instead crucial to induce polluters to optimally invest in care and accident prevention. More specifically, if polluters pay for all the losses they caused, they receive optimal care incentives. Conversely, if damages grossly deviate from the real losses, polluters do not receive optimal care incentives and more damage than what is socially desirable ultimately occurs.[2] Therefore, this article wishes to shed a brighter light on damage calculation in climate lawsuits. The existing practice of tort-law cases with claims for damages is reviewed to see whether the assessment of damages in litigation differs or not from the economic perspectives. This empirical section is built upon the database of the Sabin Center for Climate Change Law and it replicates the main distinction between US and non-US case law.

Based on both a systematic and a more attentive investigation of selected cases across the world, an interesting variety of heads of damages for climate change and related methods of quantification emerged, ranging from costs of climate adaptation to costs to re-establish carbon sinks. However, none of these methods

[1] Tribunal Administratif de Paris, Décision du 14 octobre 2021, N°s 1904967, 1904968, 1904972, 1904976/4-1, available at http://paris.tribunal-administratif.fr/content/download/184990/1788790/version/1/file/1904967BIS.pdf

[2] S. SHAVELL, *Foundations of Economic Analysis of Law*, Harvard University Press, 2004, p. 236. However, injurers should pay for all the losses they caused only under strict liability, whereas under negligence the optimal magnitude of damages can be even higher or lower compared to the magnitude of harm. In the latter case, injurers can avoid liability by taking due care (as long as the due care is set optimally). See: Cooter 1984, Landes and Posner 1987, Polinsky 1983, Posner 1986, Rose-Ackerman 1986.

seems to reflect the state of the art in climate economics. This leads the author of this article to observe that tort-based climate lawsuits might fail to provide polluters with optimal deterrence incentives if damages are not assessed in such a way that their magnitude is approximately the same as the magnitude of harm caused by climate change.

2. THE COSTS OF CLIMATE CHANGE

Traditionally, when trying to account for climate change losses, economists make a general distinction between economic and non-economic damages or losses.[3]

The former refer to goods and services traded in markets.[4] Economic losses may thus include damage to crops, homes or infrastructure.[5] The latter

[3] In the economics of climate change, the debate specifically focused on the distinction between economic and non-economic losses is better known as 'Loss and Damage' (L&D) debate. It examines in-depth the consequences of extreme weather events. Within that discussion, the term 'losses' refers to monetary harms, such as damages to buildings and private property, whereas 'damages' relate to non-monetary and irreversible effects, such as human health diseases, loss of life, coastal erosion and ecosystem impacts. In this article, the terms 'loss' and 'damage' are employed indifferently for both monetary and non-monetary consequences of climate change. For an overview of the L&D debate, see R. MECHLER, L.M. BOUWER, T. SCHINKO, S. SURMINSKI and J. LINNEROOTH-BAYER (eds), *Loss and Damage from Climate Change. Concepts, Methods and Policy Options*, Springer, Cham, 2018. Also: R. MECHLER, C. SINGH, K. EBI et al., 'Loss and Damage and limits to adaptation: recent IPCC insights and implications for climate science and policy' (2020) 15(4) *Sustainability Science* 1245, 1251.

[4] On 3 February 2022, the European Environment Agency declared that extreme weather and climate-related events, like storms, heatwaves and flooding, accounted for economic losses of around half a trillion euros over the past 40 years. See EUROPEAN ENVIRONMENT AGENCY (EEA), 'Economic losses and fatalities from weather- and climate-related events in Europe' [2022] Briefing no. 21/2021 <https://www.eea.europa.eu/downloads/8efbbcb2360a484fb04b56f993c1517c/1644508431/economic-losses-and-fatalities-from.pdf> accessed 31.08.2022. The EEA employs an updated indicator to assess data on economic losses in 32 EEA member countries (the 27 European Union Member States plus Norway, Switzerland, Turkey, Iceland and Liechtenstein) from 1980 to 2020.

[5] Clearly, extreme weather events, such as droughts or severe floods, determine a decline in economic growth with more adverse consequences in poorer regions. Let's take an example. From June to August 2022 large parts of Pakistan have been flooded as a consequence of increased monsoon rainfall due to climate change. The two southern provinces of Sindh and Balochistan received seven or eight times their usual rainfall in August. Over 33 million people have been affected by the rains and resulting floods, around 1500 people have lost their lives and more than 2 million houses have been damaged. Preliminary estimates of losses and damages were around US$ 30 billion, which included crop losses (mainly cotton and rice crops) of US$ 2,3 billion, plus industrial losses, damages to infrastructures (bridges, roads, schools and health facilties), to private properties and life-saving needs. In addition, the killed livestock and the spread of human diseases (cholera) due to stagnant flood waters had to be considered. For more information, see the scientific report by F.E.L. OTTO et al., 'Climate change likely increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan' [2022]

(noneconomic losses) relate to negative impacts of climate change that are more difficult to measure and quantify in monetary terms. They may include harm to human health, loss of cultural heritage, loss of indigenous and local knowledge, damage to biodiversity and habitats.

Despite the large evidence available in natural sciences (see § 2), research has been primarily focused on the impacts of climate change on human beings rather than on ecosystem services and nonmarket losses. This gap in the literature on climate change is mainly due to the complex challenge of quantifying ecological losses in monetary terms but also to the difficulties of identifying causal links between climate change and ecosystem degradation.[6] For these reasons, non-economic losses are often left neglected in climate-risk and cost estimates (despite their probable high magnitude) and only partially or not internalised by climate policies[7] (losses that count but are not counted).[8] Therefore, more research is needed to represent these types of damages and then incorporate them into the costs of climate change.

The graph below provides a non-exhaustive list of social costs caused by climate change, as they can be found in the economic scholarship.[9] Some of them (i.e., land losses) are pretty easy to quantify in monetary terms because they relate to changes in market prices. They indeed belong to the subcategory of 'economic losses'. Agricultural losses and damages caused by Invasive Alien Species (IAS) are worth mentioning, given that data are available and regularly updated by environmental authorities. The same applies to damages to infrastructures, which can be monetarily quantified, and to the expenses for climate displacement, which is the movement of people because of climate-induced changes of ecosystems and urban environments (i.e., costs of hotels and relocation).

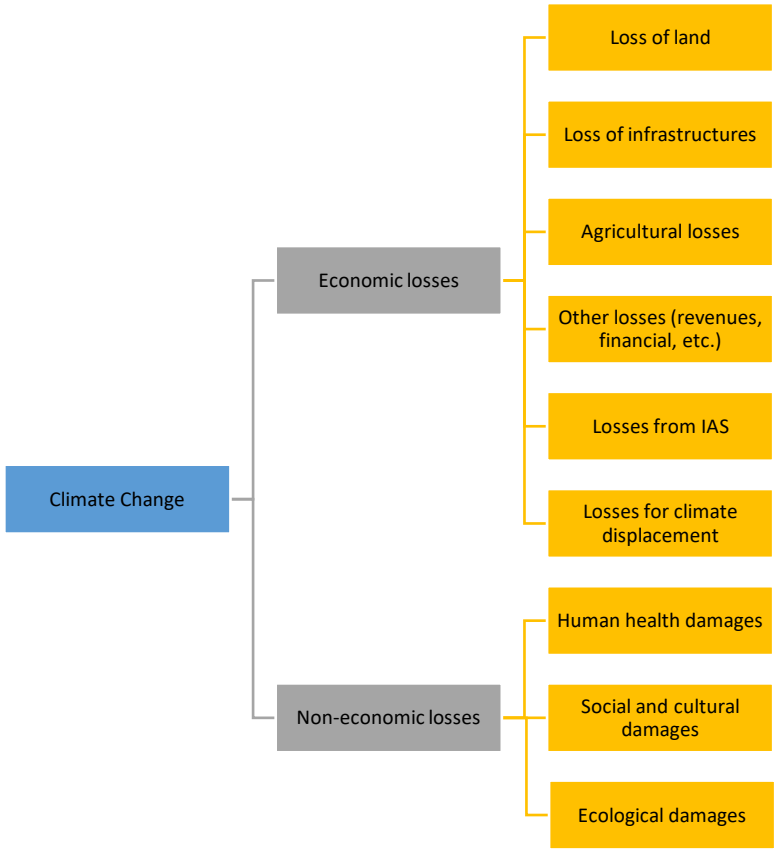
<https://www.worldweatherattribution.org/wp-content/uploads/Pakistan-floods-scientific-report.pdf> accessed 31.08.2022.

[6] Other factors, like the management of natural resources and investments in infrastructures may raise the risk of losses and damages. Moreover, some empirical evidence shows that losses and damages occurred even where adaptation measures were implemented, hence raising the need for more research on appropriate actions and new methods. See R. MECHLER et al., above n. 14.

[7] The term 'non-economic loss and damage' emerged in the negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). For an overview of challenges and policy implications, see O. SERDECZNY, E. WATERS and S. CHAN, 'Non-Economic Loss and Damage: Addressing the Forgotten Side of Climate Change Impacts' (2016) German Development Institute (DIE).

[8] Losses and damages that are difficult to be expressed in monetary terms cannot be either addressed by insurance tools. See L. SCHÄFER, K. WARNER and S. KREFT, 'Exploring and Managing Adaptation Frontiers with Climate Risk Insurance', in R. MECHLER, et al. (eds), 'Loss and Damage from Climate Change. Concepts, Methods and Policy Options' Springer, Cham, 2019.

[9] See, for instance, F. ACKERMAN and E.A. STANTON, 'The cost of climate change: what we'll pay if global warming continues unchecked' [2008] Report commissioned by the Natural Resources Defence Council <https://www.sei.org/publications/cost-climate-change-well-pay-global-warming-continues-unchecked/> accessed 31.08.2022. The report reviewed the economic impacts from climate change in the US and it distinguished them between financial damages, real estate losses, costly changes in the energy sector, water and agricultural losses.



All these costs will almost certainly increase in the future, but mitigation and adaptation measures can considerably limit their magnitude. Related expenses for adaptation and mitigation may be thus deemed as an additional category of climate-related costs.[10] So, for instance, the costs of sea level rise can be expressed as the sum of the economic value of the lost land and structures, plus the costs of coastal protection.[11]

More precisely, *mitigation* refers to actions to limit the severity of climate change impacts by reducing emissions of greenhouse gases or enhancing the sinks of emissions.[12] *Adaptation* is instead the process of adjustment to actual or future effects of climate change, rather than a one-time emergency response, a risk-

[10] For a reflection on the costs of mitigation and adaptation policies, see R.S.J. TOL, 'The Social Cost of Carbon' (2011) 3 *Annual Review of Resource Economics* 435, 443.

[11] R.S.J. TOL, S. FANKHAUSER, R.G. RICHELS AND J.B. SMITH, above n. 10, p. 2.

[12] Mitigation is about using new technologies, more renewable energies, more efficient energy equipments, changing consumer behaviours and storing gases through reforestation projects.

management strategy[13] to maintain human-ecological systems in 'a safe operating space'.[14] For instance, adaptation includes large-scale infrastructure changes, building defenses to protect against sea-level rise and any measures to cope with hazardous, exposure and vulnerability effects of current and future climate change conditions.[15]

According to Burke and others,[16] adaptation is the least explored area in climate economics despite its recognised potential of influencing and drammatically reducing the damages from climate change.[17] It is important to stress that, while damages from climate change are estimated using damage functions, the debate around the proper economic method to assess adaptation is extensive and there is still little guidance on how it should be built into damage functions.[18] Moreover, adaptation certainly increases public and private expenditures. Large differences between damage costs with and without adaptation surely require more research.

Lastly, it is common to distinguish between *avoidable* and *unavoidable* losses, where 'avoidable' refers to those damages that can be prevented through mitigation and adaptation measures.[19] For instance, the adverse effects of droughts may be prevented by planting drought-resistant crop seeds. Likewise, the damage to property caused by high tide and coastal storms may be avoided by measures to adapt to sea level rise. Yet, there are losses that are unavoidable because technical,

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[13] According to the Glossary of IPCC, adaptation options can be catagorized as structural, institutional, ecological and behavioural. IPCC [J.B.R., MATTHEWS, V. MÖLLER, R. VAN DIEMEN, J.S. FUGLESTVEDT, V. MASSON-DELMOTTE, C. MÉNDEZ, S. SEMENOV, A. REISINGER (eds)] 'Annex VII: Glossary' in 'Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change' [V. MASSON-DELMOTTE, P. ZHAI, A. PIRANI, S.L. CONNORS, C. PÉAN, S. BERGER, N. CAUD, Y. CHEN, L. GOLDFARB, M.I. GOMIS, M. HUANG, K. LEITZELL, E. LONNOY, J.B.R. MATTHEWS, T.K. MAYCOCK, T. WATERFIELD, O. YELEKÇI, R. YU, AND B. ZHOU (eds)] (2021).

[14] J. ROCKSTRÖM J, W. STEFFEN and K. NOONE, 'A safe operating space for humanity' (2009) *Nature* 461, 475. The correlation between risk levels for physical, biological and human systems, and climate adaptation scenarios have been first analysed and illustrated by IPCC in 2014. See IPCC [R.K. PACHAURI and L.A. MEYER (eds)] 'Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change' (2014).

[15] EUROPEAN COMMISSION (EC) Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change [2021] 82 final.

[16] M. BURKE et al., above n. 13, p. 1650002-6.

[17] M. CHAMBWERA et al., 'Economics of adaptation', in C. B. FIELD, V. R. BARROS, D.J. DOKKEN et al. (eds), 'Climate change 2014: impacts, adaptation, andvulnerability. Part A: global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panelon Climate Change' (2014).

[18] A. MARKANDYA and M. GONZÁLEZ-EGUINO, 'Integrated Assessment for Identifying Climate Finance Needs for Loss and Damage: A Critical Review', in R. MECHLER et al., above n. 19. The authors argued that there has not been sufficient discussion on models to estimate optimal adaptation.

[19] R. VERHEYEN, 'Tackling loss and damage' (2012) *Germanwatch*, cited by K. VAN DER GEEST, et al., 'The Impacts of Climate Change on Ecosystem Services and Resulting Losses and Damages to People and Society', in R. MECHLER et al., above n. 19.

financial or political obstacles make impossible to mitigate and adapt.[20] To explain it better, the costs to build an infrastructure and protect an island from sea level rise might be prohibitive. For this reason, losses are avoidable only within adaptation limits[21] and to the extent that they can be efficiently prevented through mitigation measures (not too high costs).

3. EMPIRICAL ANALYSIS OF THE CASE LAW

The term 'climate litigation' refers to all lawsuits brought before administrative, judicial and other investigative bodies, in domestic, international courts and organisations, raising issues of law or fact regarding climate change science, mitigation and adaptation efforts.[22] Particularly, trends and categories in climate change litigation have been in the spotlight of the legal scholarship for the last decade.[23]

Relying on the database of the Sabin Center for Climate Change Law,[24] the goal of this section is to identify all climate-related cases where plaintiffs seek compensation for damages.[25] Seemingly, tort-based claims seeking monetary compensation mainly relate to damage to lands, violation of life, health rights and moral damage (like in the French case, see § 5.2.1).[26] Conversely, direct claims only aimed at the compensation of ecological damages cannot be found. This can be explained by the fact that many jurisdictions normally foresee liability for ecological damage only where an infringement of fundamental rights is also

[20] But see footnote 20. The authors proved that a part of damages is unavoidable even under optimal adaptation policies.

[21] According to the IPCC, adaptation limits are reached when adaptation is no longer able to prevent existing risks and losses. R.J.T. KLEIN, et al., 'Adaptation opportunities, constraints, and limits', in C. FIELD, et al (eds) 'Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects', in Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change (2014).

[22] D. MARKELL and J.B. RUHL, 'An Empirical Assessment of Climate Change in the Courts: A New Jurisprudence or Business as Usual?' (2011) 64 *Florida Law Review* 15, 86; M. BURGER and J. GUNDLACH, 'The Status of Climate Change Litigation: A Global Review' (2017) Columbia Public Law Research Paper, United Nations Environment Programme.

[23] D. MARKELL and J.B. RUHL, above n. 57. See also the recent empirical study by Savaresi and Setzer on human rights based climate litigation: A. SAVARESI and J. SETZER, 'Rights-based litigation in the climate emergency: mapping the landscape and new knowledge frontiers' (2022) *Journal of Human Rights and the Environment* 7, 34.

[24] Nowadays, the world's most established climate litigation databases are those compiled by the Sabin Centre for Climate Change Law at Colombia Law School and by the Grantham Research Institute on Climate Change and the Environment at the London School of Economics.

[25] For a complete overview of the issues at stake when talking about climate change liability and the ways forward, see M. FAURE and M. PEETERS, *Climate Change Liability*, Cheltenham UK (2011).

[26] M. SPITZER and B. BURTSCHER, 'Liability for Climate Change: Cases, Challenges and Concepts' (2017) 8(2) *Journal of European Tort Law* 137, 176.

entailed.[27] The EU Environmental Liability Directive[28] set down a mechanism of compensation for ecological damage unbound from human rights. Yet, it does not entitle individuals and organisations to raise direct claims under tort law.[29] Having said that, the systematic analysis below has been conducted comparing the US with the non-US database to come up with a useful categorisation. The first part is indeed a systematic analysis of claims for climate damages. The subsequent part is instead an in-depth investigation of selected cases which stand out in terms of method of climate change damage assessment.

3.1. SYSTEMATIC ANALYSIS

The systematic analysis of US and non-US cases on compensation for climate damages followed two different custom searches.

US cases have been searched first by employing the keyword 'compensation' and then with the term 'money damages' (a recurring expression in several plaintiffs' motions seeking monetary compensation). The first query identified 14 cases out of 1,532, whereas the second query brought to 29 cases out of 1,532.[30]

To summarise, the most frequent claim for damages within the US database refers to climate change adaptation and mitigation, namely planning, monitoring and infrastructure changes to address a large spectrum of current and future damages caused by global warming, sea-level rise and extreme weather events. This claim normally relies on specific studies that estimate infrastructure improvements needed to prevent or mitigate major damage and it can be referred to past expenses or future planned costs, including estimated increases in flood insurance premiums (majority of cases). Property losses represent the second most recurring head of damages and they are based on the diminution of property value (*Comer v. Murphy Oil USA, Inc*., *Delaware v. BP America Inc*), reduced property tax (*Rhode Island v. Shell Oil Products Co.*, *King County v. BP p.l.c*.) or costs of reparation to original conditions (*Von Oeyen v. Southern California Edison Co*). Compensation for productivity losses is also quite common and it refers to the impact of climate change on agriculture, recreation, tourism and commercial sectors (*Delaware v. BP America Inc*.). Sometimes, productivity losses have been assessed in terms of reduced tax revenues from the affected sectors (*City of Charleston v. Brabham Oil Co*.). Non-economic harm has been also claimed but

[27] M. HINTEREGGER, 'Der Umweltschaden im österreichischen Privatrecht (1992) 47 *Österreichische Juristen-Zeitung* 561.

[28] Directive 2004/35/EC[2004] OJ L 143/56.

[29] M. HINTEREGGER, 'Environmental Liability', in: M. BUSSANI and F. WERRO (eds.), *European Private Law: A Handbook II* (2014) 179, 192. Under the EU Directive 2004/35/EC individuals and organisationc can only ask the public authority to take action.

[30] < http://climatecasechart.com/search/?fwp_search=money%20damages> accessed 31.08.2022; < http://climatecasechart.com/search/?fwp_search=compensation > accessed 31.08.2022.

mainly limited to annoyance, discomfort, mental anguish, fear, emotional distress and damage to physical persons (*Von Oeyen v. Southern California Edison Co*). Interestingy, claims for natural resources damages seem to be less frequent (*Platkin v. Exxon Mobil Corp*.) and in any case not accurately calculated.

For the non-US database, the employment of keywords like 'compensation' or 'money damages' did not show many results, therefore the search has been conducted by using the keywords 'compensation damages'.[31] The query allowed to identify 20 cases out of 661, with the majority from Brazil and Indonesia, where the claimed remedy is always represented by monetary compensation rather than a mere injunction. Within the 20 cases, monetary damages for climate changes have been claimed only three times, while the remaining cases refer to claims others than monetary damages. The next section will explore these three outstanding cases and it will highlight the chosen method of damage calculation by the court. Before moving to this more analytical part, the table below summarises the findings of the whole systematic analysis in an easy-to-read manner.

3.2. SELECTED CASES

Within the subgroup of non-US case-law on climate change damages, twenty cases have been found with a general reference to damage compensation. However, monetary compensation for climate change has been sought only three times in France, Brazil and Indonesia. The following sections explore these three outstanding cases with an emphasis on the explicit heads of damages and the method of damage calculation for climate change damages.

3.2.1. France[32]

On December 17, 2018, four nonprofit organizations (Fondation pour la Nature et l'Homme, Greenpeace France, Notre Affaire à Tous and Oxfam France) sent a "*lettre préalable indemnitaire*" (letter of formal notice) to the French Prime Minister to initiate a legal proceeding known as "*recours en carence fautive*" (action for failure to act). Indeed, the plaintiffs wanted to challenge the State's inaction on climate change and failure to meet its own goals for reducing greenhouse gas emissions, increasing the share of energy produced by renewable sources and reducing energy consumption. Given that the French government rejected the plaintiffs' requests, the nonprofits filed a lawsuit before the

[31] <http://climatecasechart.com/search-non-us/?fwp_non_us_search=compensation%20damages> accessed 31.08.2022.

[32] <http://climatecasechart.com/non-us-case/notre-affaire-a-tous-and-others-v-france/> accessed 31.08.2022.

Administrative Court of Paris asking to order France to a) take proper measures to reduce greenhouse gas emissions at a compatible level with the objective of limiting the rise of the global average temperature to 1.5° C (compared to pre-industrial level); b) take proper measures to achieve French targets for reducing GHGs, improving energy efficiency and developing renewable energies; c) take proper measures of climate change adaptation; d) take proper measure to protect citizens' lives and health from the effects of climate change. Last but not least, they asked compensation for two heads of damages suffered as a result of the State's failure to mitigate/adapt to the effect of climate change: moral and ecological damages. Yet, the claimed compensation was pretty symbolic and it amounted to 1 euro for moral damages and 1 euro for ecological damages. The legal ground for the requests was represented by the violation of general and specific legal duties to act on climate change. The general duties can be mainly inferred by the French Charter for the Environment[33] and the European Convention for the Protection of Human Rights and Fundamental Freedoms (article 2, right to life, and article 8, right to respect for private and family life). Further legal foundations for a right to a climate-safe environment were found into the French Environmental Code (article L. 110-1), the Stockholm Declaration, the World Charter for Nature, the Rio Declaration, the United Nations Framework Convention on Climate Change, the Kyoto protocol, the Paris Agreement, the Climate action and renewable energy package for 2020 and the Decision n°406/2009/CE of the European Parliament and of the Council dated 23 April 2009.

On 3 February 2021, the Administrative Court of Paris declared that the French government failed to take adequate action against climate change despite its duty under EU and national law, recognized climate change as pure ecological damage, awarded the plaintiffs the sum of one euro for moral prejudice as a result of inaction and ordered to disclose the steps programmed to meet climate change goals within two months.[34] The decision to issue an injunction to take stronger climate measures was deferred. Interestingly, although the court accepted compensation for moral damages, it declined to award one euro for ecological damages because the plaintiffs did not demonstrate that the government was unable to materially repair the harm caused, plus there was no connection between the amount of claimed compensation and the magnitude of true harm.[35] In October

[33] The French Charter recognises that citizens hold the constitutional right to live in a healthy and ecologically balanced environment (article 1), whereas the government has the duty to halt any serious and irreversible harm to the environment by implementing procedures for risk assessment and temporary measures commensurate with the risk (article 5).

[34] <https://laffairedusiecle.net/wp-content/uploads/2021/02/20210203-Jugement-Affaire-du-Sie%CC%80cle.pdf> accessed 31.08.2022.

[35] The exact words used by the Court were: 'The applicant associations do not demonstrate that the State would be unable to repair in kind the ecological damage for which this judgment recognizes

2021, the same judicial body ordered the State to take immediate and concrete actions by adding the 62 million extra tones of emissions from 2015 to 2018, to the reduction of emissions planned between 2021 and 2022.[36]

3.2.2. Brazil[37]

In 2018, the Ministério Público Federal (MPF) filed a lawsuit on behalf of the Amazon Task Force[38] against a Brazilian farmer (Dauro Parreiras de Rezende) for causing the deforestation of 2,488.56 hectares in the Amazon from 2011 to 2018.[39]

The claim was grounded on the right to a healthy environment as it is foreseen under the Brazilian Constitution (Art. 225, par. 3 of the Federal Constitution). Moreover, the MPF asked monetary damages for up to 85,4 million Brazilian Reais (precisely, R$ 85,399,448.75) corresponding to more than 15 million euros for:

i) property damages intended as costs of restoring the environment to the *status quo ante*; [40]

ii) residual material and intermediate climate damage;

iii) intermediate and residual damage of other natural resources;

iv) economic gains from deforestation;[41]

v) moral damage for suffering, pain, emotion, negative feeling imposed on the whole community as a result of the environmental damage.[42]

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it as responsible, on the other hand, the request for payment of a symbolic euro in compensation for the ecological damage is unrelated to its importance. It follows that this claim can only be dismissed.' (ibid., p. 35).

[36] Tribunal Administratif de Paris, Décision du 14 octobre 2021, N°s 1904967, 1904968, 1904972, 1904976/4-1 <http://paris.tribunal-administratif.fr/content/download/184990/1788790/version/1/file/1904967BIS.pdf> accessed 31.08.2022.

[37] <http://climatecasechart.com/non-us-case/ministerio-publico-federal-v-de-rezende/> accessed 31.08.2022.

[38] The Amazon Task Force has been set down by the federal public prosecutors in order to combat illegal deforestation in Amazonia.

[39] Illegal deforestation was in this case caused by an agroextractive settlement project. It is quite common in Amazonia to have extractive reserves, such as chestnut trees, rubber tappers and babassu coconut breakers which might be distorted through land grabbing in order to implement practices of deforestation and erosion of natural resources. The advance of deforestation then causes not only environmental damage but also damage to entire communities that depend on the deforested areas.

[40] More specifically, the Technical Note calculated the cost for the recovery of each hectare at € 1,941.89, bringing to a total of € 4,832,534.66 for 2488.56 hectares.

[41] This is the reimbursement of economic profits gained from the degrading activity, better known as disgorgement of profits.

[42] 'In short, from the material point of view, the fact of illegal deforestation includes both the obligation to restore the original condition of the environment in natura and the obligation to indemnify for intermediate and residual damages caused and for illicitly obtained gains, internalizing the negative effects of the offense under the environmental and social aspects. In this specific case,

This decision needs to be put within its legal and jurisprudential context in order to understand it better. First of all, under Brazilian environmental law the concept of environmental damage is pretty broad. It encompasses three main dimensions: the social aspect (harm to health and wellbeing of populations), the economic one (harm to economic activities) and the ecological dimension (harm to biota and aesthetic conditions of the environment).[43] As a consequence of such multifaceted notion,[44] the consolidate approach in the jurisprudence of the Brazilian Superior Court of Justice is to oblige the polluter to undertake environmental reparation in the most complete manner, meaning that it should cover: individual and collective harm, moral and material damages, 'interim damages' intended as temporal loss of ecosystem services between degradation and full recovery to the status quo ante, and 'residual damages' for the degradation that persists despite remedial measures.[45]

As to the method of damage assessment, Brazilian legislation doesn't offer minimum parameters for the quantification of environmental damage. It is up to the judiciary to adopt reasonable criteria of quantification for each of the heads of damage. In light of that, two different and non-excludable methodologies became common: reparation or restoration to the situation prior to the damage and compensation for intermediate damage, including residual damage. The notion of 'residual damage'[46] is peculiar since it refers to the fact that restoration can never

considering (i) the cost of restoring the environment to the status quo ante, estimated at R$ 26,732,111.50, (ii) the necessary compensation for intermediate material and residual climate damage, estimated at R$ 44,779. 679.32, (iii) intermediate and residual damages of other natures, estimated at R$ 8,019,633.45, and (iv) economic gains arising from deforestation, which must be refunded to the community, arbitrated, according to technical criteria, at R$ 5,868,024.48, the final material damage is calculated at R$ 85,399,448.75, to be repaired by the defendant.*'* (translation from the 2021 Petition, p. 34).

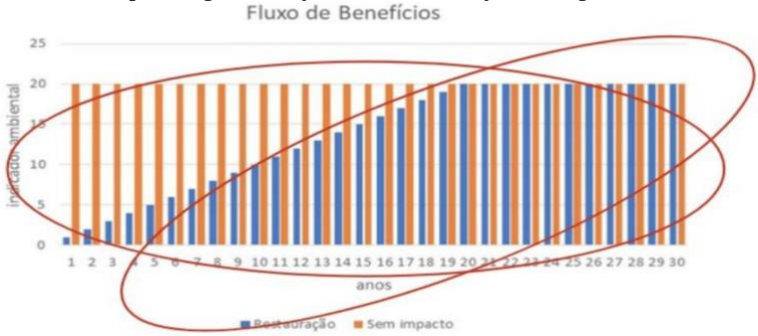
[43] Article 3 of the Law No. 6938 of 1981 provides the legal definition of pollution as degradation of the environmental quality resulting from activities that directly or indirectly harm the health and wellbeing of the population, create adverse conditions for social and economic activities, adversely affect the biota and the aesthetic conditions of the environment, discharges materials and energy in violation of environmental standards.

[44] According to the Brazilian Superior Court of Justice, 'the environmental damage is multifaceted (ethically, temporally, ecologically and financially speaking, sensitive to the diversity of the vast universe of victims, ranging from the isolated individual to the community, to future generations and to the ecological processes themselves considered)' (STJ. 2nd Panel. REsp 1.198.727/Minas Gerais. Reporting Justice Herman Benjamin, 09 May 2013).

[45] D. DE ANDRADE MOREIRA and S. LUZ ANDREATTA HERSCHMANN, 'The Awakening of Climate Litigation in Brazil: Strategies Based on the Existing Legal Toolkit', 59 *Direito, Estado e Sociedade* 172, 186 (2021).

[46] The Brazilian doctrine built the category of residual damages exactly to refer to those that remain even if all possible measures are adopted in loco for the recovery of a given degraded area. This is in line with the case-law. See, for instance, Special Appeal No. 1.180.078-MG, where Minister Herman Benjamin recognized the possibility of recovering the area, as well as compensation 'for the damage that remains between its occurrence and the full restoration of the affected environment(known as intermediate damage) as well as […] for residual damage (environmental degradation that persists despite all restoration efforts)*'*.

be full, there is always a remaining loss which is decreasing over the whole period of recovery.[47] As a consequence, any compensation is more symbolic than real, when compared to the intrinsic value of biodiversity, ecological balance or full environmental quality. Moreover valuing environmental harm is very difficult because it is hard to determine the extent to which the consequences of the environmental damage extended, considering the systemic structure of the environment.[48] Because of this traditional approach in the Brazilian jurisprudence, in the considered case the MPF added to the costs of restoration the costs of intermediate (interim) and residual damages based on the changing flux of ecosystem services pending recovery, as illustrated by the diagram below:[49]



Looking at the diagram, it is possible to see how the flux of ecosystem services (beneficios) tends to increase while the process of material reparation is carried out in order to achieve the status quo ante.

Within the above-illustrated categories of environmental damage, the plaintiff proposed a special head for climate damages intended as a measure of the permanent and temporary disturbance of the climatic services provided by the impaired forest.[50] Climate damages specifically refer to the value of greenhouse

[47] See Dicionario de Direito Ambiental, ed. Édis Milaré.

[48] Ibid.

[49] See the Petition filed by the MPF in the case in object. The Petition can be downloaded (in original language) <http://climatecasechart.com/wp-content/uploads/sites/16/non-us-case-documents/2021/20210407_13997_petition.pdf> accessed 31.08.2022.

[50] 'It should be noted that, both in the category of residual damage and in that of intermediates, climate damage can be introduced, corresponding to permanent disturbance and of the climatic services provided by the forest. If deforestation causes the emission of greenhouse gases, the emissions derived from this act and which will not be offset by the reforestation of the area correspond to the residual climatic damage. On the other hand, for what can be compensated by restoring the environment to a condition as close as possible to the status quo ante, there is an intermediate climate damage that is perpetuated until this ideal condition is reached proximity to the natural state. As already mentioned, national jurisprudence admits the relevance of indemnifying intermediate and residual damages, cumulatively with material damages that can be repaired by restoring the environment to the status quo ante.' (translation from the 2021 Petition, p. 31).

gas emissions that the illegal deforestation caused.[51] They have been already recognised by the Brazilian Superior Court of Justice in another case.[52] However, considering that Brazil has no reference value for the Social Cost of Carbon (either for those who avoid emissions or in order to tax those who emit), the value adopted by the Amazon Fund for calculating the climate impact of deforestation was US$ 5.00/tonCO2 (corresponding to almost 5 euros per ton of CO2).[53] Based on that, intermediate and residual climate damages were calculated as more than 8 million euros (equivalent to almost 45 million Brazilian Reais). Comparing this amount with the almost 5 million euros claimed as costs of restoration, it is possible to infer that the cost of returning the area to the baseline is much lower than the value of climate change damages in the case in object. This is due to the fact that carbon dioxide tends to accumulate and remain in the atmosphere, hence leading to a long-term damage lasting hundreds of years and disadvantaging entire generations to come.

The method of calculation for intermediate and residual damages to other natural resources is also worth of attention. Lacking objective parameters and considering the high value of biodiversity put at risk by deforestation, as well as the whole amount of impaired environmental services, the value of intermediate damages was estimated at 30% of the cost of repair, leading to a total of 1.4 million euros (corresponding to a bit more than 8 million Brazilian Reais).[54]

The fourth head of damages (economic gains from deforestation) was estimated by taking as a reference the commercial value of the extracted wood (around 30 m3 per each deforested hectare), which would be around 14 euros (78,6 Brazilian Reais) for almost 75,000 m3 of wood, meaning around 1 million euros (equivalent to around 6 million Brazilian Reais).

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[51] 'In the Amazon, deforestation already causes, locally and regionally, climate changes associated, for example, with the decrease in the duration of the rainy season in the south of the Amazon, with an already verified impact on agricultural productivity' (translation fromt he 2021 Petition, p. 21).

[52] Cfr. STJ, AREsp 1677537 / RS, rel. min. Francisco Falcão, Second Class, DJ 10.27.2020. In this case the FDP filed a suit against the Municipality of Santiago for illegal resource extraction and the judge condemned the municipality to pay for the costs of restoration, as well as for the intermediate and residual climate damages.

[53] 'As for these, under the climate aspect, the value adopted by the Amazon Fund for carbon pricing, of US$5.00/ton, can be used as a basis for calculating the respective impact. As Brazil does not yet have a reference value for the price of carbon, either to compensate those who avoid emissions or to tax those who promote them, here we suggest using, as a reference value, the one that was practiced in the scope do Fund-do Amazonia (USD 5.00/tonCO2)' (translation from the 2021 Petition, p. 34).

[54] 'As for other types of intermediate and residual damage, in the absence of objective parameters, and considering the richness of biodiversity put to lose with serious deforestation such as those perpetrated by the defendant and the other environmental services compromised, they are estimated at 30 % of the value of the repair cost itself, which is defined here at R$ 8,019,633.45' (translation of the 2021 Petition, p. 34).

In April 2021, the Brazilian court issued a preliminary decision granting an injunction ordering to remove from farms the cattle herd that caused deforestation. Yet, the claims on damages are still pending.

3.2.3. Indonesia[55]

On February 3, 2015, the Indonesian Ministry of Environment and Forestry (MoEF) filed a tort-based lawsuit against PT Bumi Mekar Hijau for intentionally causing fires to the peatlands in order to clear the land for timber planting purposes. The case can be considered climate-related due to the critical role of peatlands for preventing and mitigating the effects of climate change. Peatlands represent indeed the largest natural terrestrial carbon store[56] and the major source of greenhouse gas emissions and biodiversity loss when damaged.[57] In light of that, it requested the court to declare the defendant liable for damages amounting to more than 320 billion euros (equivalent to 5,299 trillion Indonesian rupiahs) and restoration costs for more than 162 billion euros (equivalent to 2,687 trillion Indonesian rupiahs). With damages and restoration cost amounting to almost 484 billion euros (8 trillion Indonesian rupiahs), this lawsuit is ranked among the highest damages in Indonesian forest fires litigation. With special regard to climate damages, the Ministry argued that fires on peatlands caused the release of 135,000 tons of carbon and 5,670 tons of CO2. The MoEF set the price for reduction and restoration of each ton of carbon on 5,44 euros (90,000 Indonesian rupiahs). Hence, the total of restoration costs for the release of carbon and carbon dioxide, respectively, were almost 726,000 euros and 260,000 euros (more exactly, 12.2 billion and 4.3 billion Indonesian rupiahs).

On December 30, 2015, the District Court of Palembang ruled in favor of the defendant and rejected all the plaintiff's claims. In fact, the judges believed that the fire did not harm the land given that it was still possible to have plants there. Yet, in May 2016, the Court of Appeal overruled the district court decision declaring that the damages had occurred in the form of air pollution and damages on the peatlands. Moreover, the method of damage assessment based on the comparison between forest fire area and a comparable area was deemed to be sufficiently accurate according to scientific norms. Lastly, it awarded the plaintiff restoration costs for climate damages in the amount of almost 5 million euros (more than 78,5 billion Indonesian rupiahs, plus court fees). All claimed heads of damages were granted but for the loss of service life, given that the area was still

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[55] <http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2016/20160212_Decision-Number-24Pdt.G2015PN.Plg_decision.pdf> accessed 31.08.2022.

[56] See: IUCN, 'Global peatland restoration : demonstrating success' (2014) <https://portals.iucn.org/library/node/47763> accessed 31.08.2022.

[57] Apparently, the decline by 60% of the Bornean orangutan population is due to the loss of peat swam habitats. The species is now classified as Critically Endangered on the IUCN Red List.

under control and maintenance of the defendant, so economic losses could not be claimed (Decision, p. 177-178).

Claimed damages can be found at page 13 (and ss.) of the Appeal Court Decision of 2016.[58] According to the Regulation of the Minister of the Environment N0. 7 of 2014, concerning Environmental Loss due to Pollution and/or Environmental Damage, ecological losses from land fires include several heads of damages, ranging from the costs of restoration to the costs of management and the costs of biodiversity loss.[59] The most interesting claims in terms of climate change damages refer to the cost of carbon release and the cost of carbon reduction due to the reduced capacity of burned trees to absorb CO2, calculated as cost to restore carbon sinks (US$10 per ton of carbon multiplied by the interested area).

In addition to the ecological losses, the economic losses needed to be added in terms of loss of service life. Assuming that the land had been cleared without burning and given that plants begin to produce at the age of 4 years while burning activities removed plant use for about 15 years, the costs that refer to 11 years of losses included: planting and maintenance costs until ready, operational costs and, finally, lost profits from Acacia production and sales for 11 years.

An additional head of damage was added due to the fact that the restoration of a peatland had to be carried out with materials close to its function, namely compost. Therefore, the costs of restoration with compost were calculated by adding the costs of compost purchase to the rental fees (with a truck 20m3 capacity) and the costs to spread compost into the soil.

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[58] The decision in Indonesian can be found at <http://climatecasechart.com/climate-change-litigation/wp-content/uploads/sites/16/non-us-case-documents/2016/20160212_Decision-Number-24Pdt.G2015PN.Plg_decision.pdf> accessed 31.08.2022. The decision is only available in original language and it has been translated with Google Translator for pdf documents.

[59] The precise list of climate damages is the following:

a) reservoir costs, the costs to build a water reservoir (construction costs per hectare or lost soil);
b) reservoir maintenance costs (costs of maintaining the artificial reservoir) for fifteen years, as set down by the Regulation 7/14;
c) water management costs per hectare and multiplied by the total area covered by the water system;
d) costs of erosion control as a consequence of burning peatland and as set down by the Regulation 7/14;
e) costs of soil forming of the burned area;
f) nutrient recycling costs (costs for the recycling of lost nutrients) for the whole burned area;
g) costs of waste decomposers lost due to peat damage, as set down by the Regulation 7/14;
h) costs of biodiversity loss (costs of restoring the lost biodiversity) as set down by the Regulation 7/14 per ha and for the total damaged area;
i) costs of lost genetic resources (including soil micro-organisms whose purpose is currently unknown and/or that is known but not fully employed) as set down in the Regulation 7/14;
l) costs of carbon release into the air as fee for every ton of carbon released as set down in the Regulation 7/14;
m) costs of carbon reduction due to the reduced capacity of burned trees to absorb CO2, calculated as cost to restore carbon sinks (US$10 per ton of carbon multiplied by the whole peatland).

As stressed by the Plaintiff, that was the total cost 'so that the land can be used again as it should be in accordance with the applicable laws and regulations'.[60]

The Plaintiff also asked to force the Defendant to pay an additional amount of money per day of delay in the implementation of the decision.

Interestingly, the decision also mentioned the dissenting opinions of judges disagreeing as to the calculation of damage because of the uncertain borders of the burned area (they contested that the area of 20 ha used as a multiplier was correct).

4. ARE CLIMATE DAMAGES INTERNALISING THE FULL COST OF CLIMATE CHANGE?

The previous empirical analysis allows to infer the following conclusions.
First of all, based on both a systematic and a more attentive investigation of selected cases across the world, an interesting variety of heads of damages for climate change and related methods of quantification emerged, ranging from costs of climate adaptation and mitigation, to costs of carbon emissions and costs to re-establish carbon sinks.

In the US, climate damages mainly refer to economic losses and, namely, costs of climate change adaptation/mitigation, losses of property values and other financial losses. Non-economic damages may be also claimed but they often refer to personal injuries and mental stress.

From an economic standpoint, the costs of adaptation and mitigation represent only one part of the total social costs of climate change and, namely, the component with the potential of considerably lowering the other part represented by damage costs. Therefore, for accurate (on average) estimates both adaptation/mitigation costs and damage costs should be taken into account, despite the fact that the relationship between the two has not been sufficiently explored in the literature. Moreover, non-economic losses referred to ecological damages are often not included in the calculation and the claimed heads of damages.

Conversely, in the non-US database, there is no common trend in the assessment of climate damages. The French lawsuit is the only EU case (based on the database of the Sabin Center for Climate Change Law) with a claim for monetary compensation of climate-related damages and it was not particularly detailed since it only referred to moral and ecological damages without further specifications. However, 'climate damages' as a separate head of damages from

[60] Reliefs claimed by the Plaintiff, Point 4, which in Indonesian sounds like: 'Menghukum Tergugat untuk melakukan tindakan pemulihan lingkungan terhadap lahan yang terbakar seluas 20.000 hektar dengan biaya sebesar Rp. 5.299.502.500.000,- (Lima Triliun Dua Ratus Sembilan Puluh Sembilan Milyar Lima Ratus Dua Juta Lima Ratus Ribu Rupiah);Sehingga lahan dapat difungsikan kembali sebagaimana mestinya sesuai dengan peraturan perundang-undangan yang berlaku' (2016 Decision, p. 23).

other economic and non-economic losses emerged in a few countries (Brazil and Indonesia). In Brazil, the notion of 'climate damages' has been developed in the courtroom and it concerns greenhouse gas emissions released by damaged forests (a fee for every ton of carbon released). Adding that to the other claimed heads of damages, the Brazilian approach seems to be much more accurate than other countries, since it overall includes: costs of restoration, damages to other natural resources, costs of carbon emissions (SCC), economic gains from the damaged resource and moral damages for the community. Yet, the value adopted to calculate the climate impact of deforestation in the considered case (US$ 5.00/tonCO2) was quite discretionary and it cannot be deemed as common practice unless future decisions will confirm that. Indonesia is the other country where plaintiffs in climate-related tort-law cases claim 'climate damages' intended as costs of carbon release into the air (fee for every ton of carbon released) and costs of carbon reduction due to the reduced capacity of burned trees to absorb CO2 (calculated as cost to restore carbon sinks). Furthermore, the method of damage assessment in Indonesia is predetermined by the law and not subject to discretionary judicial decisions. Lastly, the number of cases filed in Indonesia stands out in the database. This is possibly correlated to the high rate of illegal deforestation and to a long-standing jurisprudence favourable to the plaintiff (often, the Ministry of Environment and Forestry).
Interestingly, neither in Brazil nor in Indonesia the costs of adaptation are explicitly taken into account when claiming climate-related damages.
The three selected cases seem thus to represent three extremes in the assessment of climate damages:

France	Brazil	Indonesia
Moral damages accepted whereas ecological damages dismissed. No specific method of damage assessment. No costs of adaptation included.	Climate damages accepted but no method set down by the law. Judicial approach: US$ 5.00/tonCO2 (interim and residual damages). No costs of adaptation included.	Climate damages accepted and method of calculation set down by the law: US$10/tonCO2 (cost of carbon release and cost of lost carbon sinks). No costs of adaptation included.

Based on the economic scholarship on the assessment of climate social costs, while adding the SCC to other claims for climate-related damages seems to increase the accuracy of the total calculation, all the above-illustrated issues of uncertainty prevent us from inferring that it would determine a better internalisation of social costs of climate change. Indeed, the chosen value of SCC may be questionable, the alternative use of average abatment costs has not been

taken into account by the courts and the exclusion of adaptation/mitigation costs might cause further inaccuracies.

5. CONCLUSIONS

This article thoroughly investigated the consequences of climate change with a comparative law and economics approach and the final aim to bridge the gap between natural sciences, economics and law. The choice of this interdisciplinary approach is indeed motivated by the search of a novel perspective on the issue of damage calculation in tort-law actions seeking monetary compensation for damage causally linked to climate change.

When looking at climate change impacts, it seems that what matters from the perspective of a natural scientist is much wider compared to what matters for economists since not everything can be easily monetised (see §3) and damages awarded in litigation may represent only a minor part of the latter (see §5). Traditionally, when trying to account for climate change losses, economists make a general distinction between economic and non-economic damages. Moreover, in order to help policy-makers to define climate policies, economists developed concepts, such as the Social Cost of Carbon (SCC) or abatement costs. By weighing the SCC against the marginal cost of emissions reduction (abatement costs), it is possible to establish the efficient amount of public money to be invested in emissions reduction. Nevertheless, risks, uncertainties on future scenarios, the unknown baseline and the difficulty in monetising ecological losses might make final estimates very debatable. Indeed, there is no consensus in economics on how to assess the social costs of climate change. On the other hand, climate scenarios and expected damages further raise the need for precautionary action.[61] In view of that, liability lawsuits may represent a cost-effective tool to achieve damage prevention. This is because polluters tend to weigh the expected costs of the injury against the costs of prevention in order to take decisions on risky activities.[62] In other words, they decide how much to invest in prevention based on their expected liability. If the magnitude of liability largely underestimates that of harm, it is highly unlikely that those contributing to climate change adopt efficient behaviours to minimise climate related costs.[63] Yet, the

[61] R.S.J. TOL, S. FANKHAUSER, R.G. RICHELS and J.B. SMITH, above n. 10, p. 17.

[62] R. POSNER, 'A Theory of Negligence' (1972) 1 *Journal of Legal Studies* 29, 96.

[63] For an overview of arguments supporting the opposite thesis, i.e. that the internalization of full costs might drive companies out of businesses, see M. SPITZER and B. BURTSCHER, above n. 60, 160. An additional issue is to achieve an optimal distribution of liabilities across the business sector. See D.A. FARBER, 'Apportioning Climate Change Costs' (2008) 26 *UCLA Journal of Environmental Law and Policy* 21, 41. In light of this and several other issues raised by claims for climate damages, Spier put forward the idea of injunctive reliefs. See J. SPIER, 'Injunctive

extent of internalization of climate change costs via liability laws is largely unknown. Drawing on the previous analysis, the current trend in claiming and assessing climate damages in litigation casts doubts on whether they fully internalise the social costs of climate change.

Lastly, the empirical analysis shows that climate change is influencing the choice of remedies for environmental liability in various ways. Sometimes, plaintiffs contend that the same choice of remedies was unreasonable in light of current climate adaptation programmes. For instance, in *United States of America* v. *Hercules, LLC*, the State asked the defendant to perform a remedial action that could assuage the concerns of rising sea levels, storm surges and hurricanes due to its degree of permanence and resilience. Likewise, in *In re General Electric Co.*, the plaintiffs (two citizen advocacy groups) challenged the choice of onsite disposal because it could not be guaranteed forever against leakage 'especially considering the effects of climate change' (the risks of disturbance of contaminated sediment during climate-related disasters). These cases show that climate change is providing an additional argument in the hands of plaintiffs to question remedies. Moreover, an 'abatement fund' as a special remedy has been sometimes proposed to provide the needed infrastructures for sea level rise adaptation (e.g., *City of Oakland v. BP p.l.c.*; *King County v. BP p.l.c.*).

Relief: Opportunities and Challenges: Thoughts About a Potentially Promising Legal Vehicle to Stem the Tide', in J. SPIER and U. MAGNUS (eds), *Climate Change Remedies*, Eleven International Publications, The Hague, 2013.