Financial Security Mechanisms to Cover Biodiversity Damage Resulting from the Use of Genetically Modified Organisms

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FINANCIAL SECURITY MECHANISMS TO COVER BIODIVERSITY DAMAGE RESULTING FROM THE USE OF GENETICALLY MODIFIED ORGANISMS*

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INTRODUCTION

In 2000, the Cartagena Protocol on Biosafety was adopted.[1] It was negotiated under the Convention on Biological Diversity (CBD) and provides an international legal framework for the safe transfer, handling, and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, considering risk to human health.[2] In accordance with Article 27 of the Cartagena Protocol, a process was adopted for the negotiation of international rules and procedures on liability and redress for damage arising from transboundary movements of LMOs.[3] After six years of intense negotiations,[4] the Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety (NKLSP) was adopted in 2010.[5] The NKLSP takes an administrative approach to response measures in the event of damage, or sufficient likelihood of damage, to the conservation and sustainable use of biological diversity resulting from LMOs that find their origin

[1] *See generally* Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Jan. 29, 2000 [hereinafter Cartagena Protocol], https://bch.cbd.int/protocol.

[2] The terms "living modified organism" and "modern biotechnology" are defined in Article 3 of the Cartagena Protocol on Biosafety and apply also to the NKLSP. *See* Cartagena Protocol, *supra* note 1, art. 3; Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety, Sept. 11, 2003 [hereinafter NKLSP], https://bch.cbd.int/protocol/NKL_text.shtml.

[3] Cartagena Protocol, *supra* note 1, art. 27.

[4] Gurdial Singh Nijar, *The Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety: An Analysis and Implementation Challenges*, 13 INT'L ENV'T AGREEMENTS: POL., L. & ECON. 271, 272 (2013). *See generally* René Lefeber & Jimena Nieto Carrasco, *Negotiating the Supplementary Protocol: The Co-Chairs' Perspective*, *in* INTERNATIONAL LIABILITY REGIME FOR BIODIVERSITY DAMAGE: THE NAGOYA–KUALA LUMPUR SUPPLEMENTARY PROTOCOL 52, 52–70 (Akiho Shibata ed., 2016).

[5] For a further analysis of the liability regime in this NKLSP, see Nijar, *supra* note 4, at 271–90; s*ee also* ANCUI LIU, REGULATING GENETICALLY MODIFIED CROPS IN VIEW OF ENVIRONMENTAL RISKS: CHINA'S IMPLEMENTATION OF INTERNATIONAL OBLIGATIONS 42–43 (2022). For a further analysis of liability and redress under the Cartagena Protocol, see GURDIAL SINGH NIJAR, SARAH LAWSON-STOPPS & GAN PEI FERN, LIABILITY AND REDRESS UNDER THE CARTAGENA PROTOCOL ON BIOSAFETY: A RECORD OF MALAYSIA'S POSITION IN THE NEGOTIATIONS FOR DEVELOPING INTERNATIONAL RULES (2008).

in transboundary movements.[6] As far as financial security is concerned, Article 10(1) of the NKLSP provides that "[p]arties retain the right to provide, in their domestic law, for financial security."[7] Further, Article 10(3) of the NKLSP provides that:

> The first meeting of the Conference of the Parties serving as the meeting of the Parties to the Protocol [COP-MOP] after the entry into force of the Supplementary Protocol shall request the Secretariat to undertake a comprehensive study which shall address, *inter alia*:
>
> a) The modalities of financial security mechanisms;
>
> b) An assessment of the environmental, economic, and social impacts of such mechanisms, in particular on developing countries; and
>
> c) An identification of the appropriate entities to provide financial security.[8]

This article presents the result of this study with respect to the modalities of financial security mechanisms as announced in Article 10(3) of the NKLSP. In preparation, the following sources were consulted: reports and studies prepared for the negotiations of the NKLSP,[9] available economic literature dealing with the various types of financial security available, and literature outlining existing financial security mechanisms established for environmental damage[10] (other than damage from LMOs).[11]

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[6] Nijar, *supra* note 4, at 289; Lefeber & Carrasco, *supra* note 4, at 24–28; Guardial Singh Nijar, *Civil Liability in the Supplementary Protocol*, *in* INTERNATIONAL LIABILITY REGIME FOR BIODIVERSITY DAMAGE: THE NAGOYA–KUALA LUMPUR SUPPLEMENTARY PROTOCOL 111–17 (Akiho Shibata ed., 2016).

[7] NKLSP, *supra* note 2, art. 10(1).

[8] *Id.* art. 10(3).

[9] Including detailed studies concerning financial security for LMOs provided by international (re) insurance. *See* Executive Secretary of the Convention on Biological Diversity, *Financial Security to Cover Liability from Transboundary Movements of Living Modified Organisms*, UNEP/CBD/BS/WG-L&R/2/INF/7 (Feb. 13, 2006) [hereinafter CBD Secretariat 2006], https://www.cbd.int/doc/meetings/bs/bswglr-02/information/bswglr-02-inf-07-en.pdf; *see also* Executive Secretary of the Convention on Biological Diversity, *Financial Security to Cover Liability Resulting from Transboundary Movements of Living Modified Organisms*, UNEP/CBD/BS/WG-L&R/3/INF/5 (Jan. 10, 2007) [hereinafter CBD Secretariat 2007].

[10] For example, the harm related to offshore oil and gas activities is discussed in MICHAEL FAURE, CIVIL LIABILITY AND FINANCIAL SECURITY FOR OFFSHORE OIL AND GAS ACTIVITIES (2018). The carbon capture and storage are discussed in MICHAEL FAURE & ROY PARTAIN, CARBON CAPTURE AND STORAGE: EFFICIENT LEGAL POLICIES FOR RISK GOVERNANCE AND COMPENSATION (2017).

[11] One note on terminology: the Cartagena Protocol and the NKLSP refer to LMOs. Where this article includes examples from the literature referring to GMOs, the terminology in the example has been maintained.

Most of the literature with respect to the NKLSP dates from the period just after its adoption.[12] All relevant literature that could be found has been included, but since 2015, relatively little has been published on the NKLSP. Furthermore, many of the examples concerning financial security mechanisms established for environmental damage come from the European or developed world context, as fewer examples from other regions were available.

The goal of this article is to sketch the modalities, including the advantages and disadvantages of different financial security mechanisms. The structure is, to an important extent, determined by the topics addressed in Article 10(3) of the NKLSP. Section II addresses the risks to be covered in order to identify which particular risks financial security is sought for. Section III provides an overview of the modalities of potential financial security mechanisms and of the potential entities that could provide financial security. Section IV provides an assessment of the economic, social, and environmental impacts of the various mechanisms, with a specific focus on developing countries.

It is important to note the type of damage to which the NKLSP focuses is primarily damage to biodiversity. Damage is defined in Article 2(2)(b) of the NKLSP as "an adverse effect on the conservation and sustainable use of biological diversity, taking also into account risks to human health, that: (i) [i]s measurable . . . and (ii) [i]s significant."[13] This will be referred to as "damage to biodiversity" in this article. However, most of the literature dealing with financial security for LMOs primarily focuses on traditional damage that may result from non-LMOs, for example, comingling of LMOs with non-LMOs.[14] These examples will be discussed because they help to illustrate the points being described in light of the scarcity of literature addressing financial security for damage to biodiversity covered by the NKLSP, even though these examples may

[12] CORDONIER MARIE-CLAIRE SEGGER, FREDERIC PERRON-WELCH & CHRISTINE FRISON, LEGAL ASPECTS OF IMPLEMENTING THE CARTAGENA PROTOCOL ON BIOSAFETY (2013) (discussing legal aspects of implementing the Cartagena Protocol on Biosafety). Liability and redress under the Cartagena Protocol is discussed in NIJAR, LAWSON-STOPPS & PEI FERN, *supra* note 5 (discussing liability and redress under the Cartagena Protocol). *See also* Akiho Shibata, *A New Dimension in International Environmental Liability Regimes: A Prelude to the Supplementary Protocol*, *in* INTERNATIONAL LIABILITY REGIME FOR BIODIVERSITY DAMAGE: THE NAGOYA–KUALA LUMPUR SUPPLEMENTARY PROTOCOL 17–51 (Akiho Shibata ed., 2016) (discussing the liability regimes developed by the NKLSP). *See generally* LIU, *supra* note 5 (providing the most recent monograph devoted to legal aspects of LMOs).

[13] NKLSP, *supra* note 2, art. 2(2)(b).

[14] *See, e.g.*, Bernhard A. Koch, *Comparative Report*, *in* ECONOMIC LOSS CAUSED BY GENETICALLY MODIFIED ORGANISMS: LIABILITY AND REDRESS FOR THE ADVENTITIOUS PRESENCE OF GMOS IN NON-GM CROPS 585, 585–651 (Bernhard A. Koch ed., 2008).

be less pertinent for the biodiversity damage covered by the NKLSP. Many of the examples covered in the literature deal with the use of LMOs in agriculture, although the applications of LMOs are wider than their use as agricultural crops only. However, as most of the examples and discussions provided in the literature refer to agriculture, those are the examples that will most often be discussed. The reader should be aware that the application of LMOs is broader than just in plants and agriculture and that the focus of the NKLSP is on damage to biodiversity.

I. BACKGROUND: STARTING POINTS AND CHALLENGES

This section aims to explain in simple terms what financial security is and what purpose(s) it serves. Also, some of the difficulties and challenges in providing financial security for damage to biodiversity will be highlighted.

A. Potential Damage and Risk Scenarios

The NKLSP covers damage to biodiversity on the condition it is measurable or observable, taking into account available scientifically established baselines recognized by a competent authority.[15] The damage must, moreover, be significant. Article 2(3) of the NKLSP provides criteria for determining whether a particular adverse effect is significant.[16] The problem with seeking financial security for damage to biodiversity is that the damage could appear under a wide variety of different risk scenarios.[17] This can lead to two related issues with the provision of financial security: (1) because LMOs could cause damage under a wide variety of risk scenarios, it is at present difficult to assess whether currently-existing financial security mechanisms (e.g., insurance) do provide cover for a specific type of damage to biodiversity caused by LMOs,[18] and (2) the wide variety of possible risk scenarios may equally make it difficult to develop dedicated financial security in the future.[19]

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[15] NKLSP, *supra* note 2, art. 2(2)(b); Nijar, *supra* note 4, at 273.

[16] NKLSP, *supra* note 2, art. 2(3).

[17] Also, during the negotiations preceding the NKLSP, different damage scenarios were reviewed. *See* Nijar, *supra* note 4, at 283.

[18] This may depend upon the type of loss, cause of loss, alleged wrong, and the manner in which the coverage was written. *See* Casey Roberts, *GMOs: A Primer (of Sorts)*, IRMI (May 2020), https://www.irmi.com/articles/expert-commentary/gmo-primer.

[19] *See generally* Kenneth J. Arrow, *Uncertainty and the Welfare Economics of Medical Care*, 53 AM. ECON. REV. 941 (1963).

B. Reason for Financial Security[20]

Financial security can be seen as a mechanism to protect against risk. Risk can be expressed as the probability that an event that causes a particular damage might occur.[21] There may be various reasons why there would be a demand for financial security to deal with risk. The first reason is risk aversion.[22] Individuals often have an aversion against risks with a potentially high magnitude of damage, especially when that damage could endanger their entire wealth. Given the limited assets of most individuals, a majority of the population is averse to risk and may seek financial security (e.g., insurance) to be protected from it.[23] Risk aversion is, therefore, strongly dependent upon the scale of the expected damage in relation to one's own wealth.

A second reason for financial security is that, in the case of insolvency, operators may not be able to cover their potential liability exposure, and a so-called "judgment proof-problem" would arise.[24] The potential insolvency of an operator is problematic from two perspectives: (1) it would imply that the remedies related to liability and redress cannot be executed (i.e., restoration cannot take place or victims will not be compensated), and (2) when an operator is insolvent, the preventive effect of liability rules will likely fail.[25] Therefore, the duty imposed on the operator to compensate for the damage caused can provide an incentive for prevention, but when the operator is insolvent and would not be able to meet its financial obligations, the operator would lack the incentive to prevent the damage. For those reasons, the legislator can impose an obligation to seek financial security on the operator when there is a danger of

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[20] In the literature a variety of different terms are used to cover the same issue, such as "financial assurance" or "bonding requirements." *See* Colin Mackie & Laurel Besco, *Rethinking the Function of Financial Assurance for End-of-Life Obligations*, 50 ENV'T L. REP. 10573, 10573–603 (2020).

[21] This goes back on Frank Knight's famous distinction between risk and uncertainty. *See* FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT 214–17 (2013); Mind Tools Content Team, *Risk Impact/Probability Charts*, MINDTOOLS, https://www.mindtools.com/ah8ju2z/risk-impactprobability-charts (last visited Jan. 29, 2023).

[22] Arrow, *supra* note 19, at 946, 959.

[23] *Id.* at 959–60; *see also* KENNETH J. ARROW, ASPECTS OF THE THEORY OF RISK-BEARING 28–29 (1965).

[24] Referring to the fact a victim could obtain a judgment against a liable operator but may not be able to execute it as a result of the operator's insolvency. *See* Steven Shavell, *The Judgment Proof Problem*, 6 INT'L REV. L. & ECON. 45, 45 (1986).

[25] *See generally id.*

insolvency.[26] Financial security is thus important to guarantee victim compensation and to provide incentives to the operator for prevention.[27]

C. Liability and Redress

The risk in the particular case of the duties under the NKLSP relates to the specific obligations of operators of the LMO. The obligations of operators arise primarily under Article 5 of the NKLSP, related to response measures.[28] They may also arise under Article 12, related to civil liability, depending on domestic legal frameworks.

With regard to response measures, the NKLSP requires Parties to impose responsibilities on an operator to evaluate damage and take response measures. These response measures are defined in Article 2(2)(d)(ii) and can lead to costs for which the operator may seek financial security.[29]

In addition to the obligations arising under Article 5 of the NKLSP, obligations may arise from civil liability rules and procedures under domestic law in accordance with Article 12 of the NKLSP.[30] Article 12 establishes a right for Parties to address damage resulting from LMOs through civil liability rules and procedures.[31] Civil liability for material or personal damage is only covered by the NKLSP to the extent it is associated with biodiversity damage as defined in Article 2(2)(b).[32] The specific contents of the liability provision will depend upon the way in which domestic law has implemented the various aspects of Article 12.[33] A market demand for financial security can, therefore, also emerge to cover the risk of liability under domestic law in the implementation of Article 12.

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[26] Michael Faure, *Economic Criteria for Compulsory Insurance*, 31 GENEVA PAPERS RISK & INS. ISSUES & PRAC. 149, 149 (2006); Peter-J. Jost, *Limited Liability and the Requirement to Purchase Insurance*, 16 INT'L. REV. L. & ECON. 259, 259 (1996); Mattias K. Polborn, *Mandatory Insurance and the Judgment-Proof Problem*, 18 INT'L. REV. L. & ECON. 141, 141 (1998).

[27] Polborn, *supra* note 26.

[28] NKLSP, *supra* note 2, art. 5.

[29] *Id.* art. 2(2)(d)(ii).

[30] Nijar, *supra* note 4, at 277.

[31] NKLSP, *supra* note 2, art. 12.

[32] Nijar, *supra* note 4, at 273.

[33] *Id.* at 276–77; Anastasia Telesetsky, *The Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress*, 50 INT'L LEGAL MATER 105, 111–12 (2011); Stefan Jungcurt & Nicole Schabus, *Liability and Redress in the Context of the Cartagena Protocol on Biosafety*, 19 REV. EUR. CMTY. INT'L & ENV'T L. 197, 201–02 (2010).

D. Damage Versus Liability: First- and Third-Party Cover

There are two fundamentally different ways of providing financial security: first party and third party (financial security).[34] It is a distinction mostly made in the context of insurance but applicable to other mechanisms as well.

First-party financial security schemes provide cover to an individual (or firm) who is exposed to a particular risk where the potential victim seeks financial security for that particular risk.[35] In this situation, the financial cover is provided directly to the person or entity exposed to the risk, and as a consequence, that entity will also pay an insurance premium for that financial security.

Third-party financial security schemes provide financial security to cover the risk that an operator may have to compensate for damage suffered by a third party on the basis of the liability of the operator.[36] It is referred to as a third-party cover because the financial cover provided for an operator will be liable to cover the damage suffered by a third party (the victim) rather than the potential victim seeking financial cover. Liability insurance is a typical example of third-party cover.

The difference between first-party and third-party cover is important as some claim it is easier to provide first-party cover than third-party cover,[37] and there are obvious distributional differences as well. In the case of first-party cover, it is the potential victim who pays for the financial security to cover the risk to which it is exposed.[38] In the case of third-party cover, it is the liable operator who pays for the financial security that will benefit the third party (victim).[39] In the context of LMOs, there could potentially be both first-party as well as third-party cover.[40] At the same time, however, as the NKLSP focuses primarily on damage to biodiversity, third-party mechanisms may be more relevant for dealing with that type of damage.

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[34] Convention on Biological Diversity, *Study on Financial Security Mechanisms (Article 10 of the Nagoya–Kuala Lumpur Supplementary Protocol on Liability and Redress*), at ¶ 10, CBD/CP/MOP/10/INF/1 (Oct. 11, 2021) [hereinafter *Study on Financial Security Mechanisms*].

[35] *Id*.

[36] *Id*.

[37] George L. Priest, *The Current Insurance Crisis and Modern Tort Law*, 96 YALE L.J. 1521, 1521 (1987).

[38] *See* CBD Secretariat 2007, *supra* note 9, at 2–3 (discussing the relevance of the distinction between first-party and third-party cover for LMOs).

[39] *Id*.

[40] *Id*.

A challenge relates to the fact that most of the literature on financial security deals with comingling and the adventitious presence of LMOs in agriculture and associated property damage to farmers that may arise in these cases.[41] It explains why most of the literature dealing with financial security for LMOs discusses first-party rather than third-party mechanisms.[42] Again, as there is hardly any discussion of third-party mechanisms for LMO-related damage, the literature discussing first-party mechanisms will still be presented. However, the reader should be aware that for the damage to biodiversity (which is the focus of the NKLSP), third-party mechanisms may be more important.

E. Uncertainty

In the case of the potential damage related to LMOs, there may not only be a risk, but also uncertainty.[43] Risk indicates there is a probability (e.g., ten, thirty, or fifty percent) that an event leading to damage will occur.[44] When there is a risk, the probabilities are known. In the case of uncertainty, the probabilities are simply unknown.[45] The uncertainty does not only relate to the probability that harm will occur but also to the potential magnitude or scale of the damage.[46] The uncertainty for financial security providers relates to two issues. First, there is uncertainty concerning the potential impacts of LMOs on the conservation of sustainable use of biodiversity.[47] Second, there is uncertainty concerning civil liability regimes as they relate to LMOs as these regimes depend upon implementation in domestic law.[48] These issues make financial institutions reluctant to cover LMO-related risks.[49] Additionally, these uncertainties were

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[41] *E.g.*, Koch, *supra* note 14. Property damage for a farmer is not necessarily covered under the NKLSP. Material or personal damage that is associated with damage defined in Article 2(2)(b) is to be addressed under a Party's domestic civil liability legislation in accordance with Article 12(2). *Study on Financial Security Mechanisms*, *supra* note 34.

[42] *See, e.g.*, Ina Ebert & Christian Lahnstein, *GMO Liability: Options for Insurers*, *in* ECONOMIC LOSS CAUSED BY GENETICALLY MODIFIED ORGANISMS: LIABILITY AND REDRESS FOR THE ADVENTITIOUS PRESENCE OF GMOS IN NON-GM CROPS 577–81 (Bernhard A. Koch ed., 2008).

[43] Koch, *supra* note 14.

[44] Note that risk of LMOs assessed by risk assessors, as part of the LMO regulatory process, is not necessarily the same analysis of risk that would be considered by a financial security provider.

[45] Stephen F. LeRoy & Larry D. Singell, *Knight on Risk and Uncertainty*, 95 J. POL. ECON. 394, 394–406 (1987).

[46] *Id.*

[47] Jungcurt & Schabus, *supra* note 33, at 201.

[48] Telesetsky, *supra* note 33.

[49] Jungcurt & Schabus, *supra* note 33, at 204; John James, *Genetic Engineering: A "Potential" Emerging Coverage Issue?*, FINDLAW (Mar. 26, 2008), https://corporate.findlaw.com/law-library/genetic-engineering-a-potential-emerging-coverage-issue.html.

largely recognized during the process leading to the NKLSP. A 2003 conference report on biotechnology by the Swiss Reinsurance Company (Swiss Re) mentions that the risk posed by GM crops is estimated to be very low, but there remains uncertainty with regard to the impact of such crops on wildlife, among other things.[50] Notwithstanding the estimated low probability, the insurers are still reluctant to cover LMO-related risks.[51] A key reason is that even with a low probability there is uncertainty with respect to the magnitude of the potential damage, which makes it challenging to do the calculations necessary for determining the premiums. Uncertainty and complexity may change in view of the rapid evolution of biotechnologies.

F. Various Stakeholders

The potential risks to which particular actors are exposed may differ, depending, to some extent, on their specific position in the supply chain of LMOs. Consequently, the demand for or obligation to obtain financial security of these actors may differ. Developers, producers, exporters, importers, and distributors of LMOs may face different exposure to liability, and a different type of financial security mechanism may be suitable for each operator.[52] Parties have discretion to decide which operator is liable, according to domestic law.[53] Since determining the operator is at the discretion of the competent authority, the operator could be anyone from a large commercial producer or distributor to a small farmer. In order to offer financial security that is suited to each of these actors, the financial security mechanisms should be sufficiently flexible and diverse.[54] For now, it suffices to say the market demand for financial security may well depend upon the particular position of the actor within the LMO supply chain and the corresponding exposure to risk.

II. FINANCIAL SECURITY MECHANISMS

A. Introduction

This section describes the modalities of several financial security mechanisms, including: (1) a description of the mechanism, (2) the conditions

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[50] *See* CBD Secretariat 2006, *supra* note 9, Annex B.

[51] *Id*.

[52] *See also* Koch, *supra* note 14, at 615–18; Nijar, *supra* note 4, at 276.

[53] NKLSP, *supra* note 2, art. 12.

[54] Telesetsky refers to the market distributor, the scientific developer, and the transporter of the LMO. *See* Telesetsky, *supra* note 33.

that must be fulfilled for the mechanism to work, (3) examples, where available, of the existence of the mechanism for damage from LMOs and environmental damage, (4) an analysis of the suitability of the mechanism to provide adequate compensation and incentives for prevention, and (5) the potential role of the government and other stakeholders in creating an enabling environment for the particular mechanism. Many financial security mechanisms exist or could theoretically be devised. This article will focus on a selection of more widely explored and practical financial security mechanisms while also giving some consideration to alternative financial security mechanisms.

The following mechanisms will be reviewed in more detail:

- (re)insurance (B);
- self-insurance (C);
- risk-pooling (D); and
- funds (E).

For each financial security mechanism, the appropriate entities that could provide the financial security will also be identified.[55] Section F will briefly discuss a few other financial security mechanisms that are considered less suitable for covering LMO-related damage.

The reason to focus on those four mechanisms is that they are also mentioned in other conventions and that these instruments were discussed during the negotiations preceding the Supplementary Protocol (SP).[56] The literature also refers to those mechanisms.[57] A note concerning financial security explicitly referred to insurance, bank guaranties, internal reserves and industry pooling schemes among other mechanisms.[58] Some of the other mechanisms mentioned, such as *ex ante* guarantees or the use of the capital markets (via bonds) will not be analyzed as they are not the most likely candidates to effectively cover

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[55] In line with Article 10(3)(c) of the NKLSP. *Study on Financial Security Mechanisms*, *supra* note 34.

[56] A comparison was made with the instruments available according to the protocol on liability and compensation for damage resulting from transboundary movements of hazardous wastes and their disposal in the framework of the Basel Convention. The absence of insurance policies, bonds, or financial guarantees was considered an obstacle to ratifying the Basel Protocol. *See* UNEP, Quarterly Report on The Administration of the Convention on Biological Diversity, UNEP/CBD/QR/31 CBD (Dec. 31, 2005), at Annex II, 10–11. Besides, various regulations can have many different measures by which operators show their ability to pay. *See* Mackie & Besco, *supra* note 20, at 10574.

[57] Jungcurt & Schabus, *supra* note 33, at 204.

[58] *Id.* at 197, 204. Self-insurance, risk-sharing agreements, *ex ante* guarantees, and deposits into an environmental savings account are mentioned as alternatives to third-party liability insurance.

environmental harm.[59] *Ad hoc* state compensation can always take place,[60] but does not need a specific regulatory framework.

The modalities of each of the four mentioned financial security mechanisms will be analyzed according to a similar structure by discussing:

- what the mechanism contains from a descriptive perspective;
- the conditions that theoretically must be fulfilled to apply the mechanism;
- whether the particular mechanism exists in practice either for LMOs or for other types of environmental harm; and
- a brief analysis of the particular mechanism based two criteria whether the particular mechanism is able to provide adequate compensation and whether the mechanism equally provides incentives for prevention; and
- the potential role of the government in providing additional funding for catastrophic risks.

This structure is in line with the NKLSP, which itself stresses both the need to provide compensation, as well as the importance of preventing damage.[61] From the outset, it should be mentioned that the NKLSP itself contains several features that already facilitate the provision of financial security. It is important, in this respect, as mentioned above, that the notion of damage is narrowly defined by requiring the damage of biodiversity to be measurable or observable; that the assessment needs to take into account, where available, scientifically established baselines recognized by a competent authority; and the adverse effect must be significant as defined in Article 2(3) of the NKLSP.[62] These important elements facilitate the provision of financial security for all mechanisms, as they generally require a certain predictability of harm.[63]

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[59] FAURE & PARTAIN, *supra* note 10, at 177–82 (addressing that guarantees and deposits were discussed in the framework of potential damage related to carbon capture and storage (CCS) but not considered very practical, and bonds were, for a variety of reasons, not met with great enthusiasm either).

[60] Although it was met with criticism in the literature. *See, e.g.*, Giuseppe Dari-Mattiacci & Michael Faure, *The Economics of Disaster Relief*, 37 L. & POL'Y 180, 180–208 (2015).

[61] Prevention and remediation of damage caused to LMOs are clearly the declared objectives of the NKLSP. *See* Nijar, *supra* note 4, at 272.

[62] Nijar, *supra* note 4, at 273.

[63] Even though this requirement is, as will be explained, more important for some mechanisms, like insurance, than for others as insurance requires the *ex-ante* determination of a premium, whereas others do not necessarily.

B. Insurance and Reinsurance

1. Description

Insurance, in its most simple form, is a mechanism where a particular risk is shifted by the party exposed to that risk (the insured) to another entity (the insurance company).[64] The reason an insurance company can take over the risk is the law of large numbers: because a large number of individuals exposed to a similar risk can be pooled together, the insurer can spread the risk over the entire pool.[65]

As explained in Section II.C. above, there is an important distinction between first-party insurance (where the insured is covered for his own loss) and third-party insurance (where the insured is covered for damage inflicted on a third party). First-party insurances can, therefore, theoretically provide cover, for example, to farmers against consequences of risks such as natural disasters like hail or storms.[66] An example of a third-party insurance would be a seed supplier (or developer) taking out insurance for potential liability towards third parties caused by LMOs.[67]

2. Conditions

Theoretically, many conditions need to be fulfilled for a particular risk to be insurable.[68] A crucial condition is that a sufficiently large number of insured must be included in the pool. This is a consequence of the fact that insurance is based on the law of large numbers, as statistical predictability can only be created when a large enough insurance pool is created in order to spread the risk. A large number of insured is, moreover, also necessary in order to collect the premium income needed to cover the damage.

Additionally, insurers need to have sufficient information to be able to calculate a premium. In simple terms, the premium is the result of multiplying

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[64] Koch, *supra* note 14, at 615.

[65] *Id*. All the insured in the risk-pool share the risk by paying the insurance premium. The sum of all the premiums together will allow the insurance company to compensate the insured who suffers a loss, i.e., the insured risk.

[66] Koch, *supra* note 14, at 618–20.

[67] *Id*. at 617–18.

[68] Conditions of insurability have been discussed in the literature. *See* MICHAEL FAURE & TON HARTLIEF, INSURANCE AND EXPANDING SYSTEMIC RISKS 81–120 (2003) [hereinafter FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS]; *see also* CBD Secretariat 2006, *supra* note 9, at 10.

the probability by the potential compensation due.[69] This results in what is called the actuarially fair premium. In order to determine the probability with known risks, the insurer relies on statistics.[70] These statistics are usually derived from past damage and risk histories.[71] When there is little or no information on the damage or the probability, insurers are unable to calculate an actuarially fair premium, and this may lead to "uninsurability."[72] In that case, to some extent, modeling and risk assessment models could be used. However, insurers may have doubts when there is little information with respect to the probability and uncertainty about the magnitude of the potential damage. It is a situation referred to as "insurer ambiguity," which may lead an insurer to charge an additional risk premium.[73] In some cases, there may be a different perception of the risk between, for example, an operator seeking insurance coverage who considers the risk to be fairly low versus the insurer who may have less information and, as a result of insurer ambiguity, demands a relatively high premium.

Another prerequisite for insurability is that there must be a demand for insurance. As a result of a wide variety of problems, such as an insured lacking financial ability (e.g., small farmers being unable to pay the premium for agricultural insurance) or lack of awareness of the risk, or psychological biases, such a demand may not emerge. For insurability, it is thus essential that insurance premiums are affordable and insured persons are aware of the risk. When the demand for insurance for LMO-related risks is small, this could create a hurdle to insurability.

Another condition of insurability is that the problems of adverse selection and moral hazard.[74] Adverse selection refers to the fact that insurance is always more attractive for those who are exposed to higher risks and who would, therefore, be more in need of insurance. If insurance only attracted those high risks, uninsurability would arise.[75] Moral hazard refers to the tendency of fully insured individuals to increase the risks they take, as they themselves are no

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[69] Howard Kunreuther, Robin Hogarth & Jacqueline Meszaros, *Insurer Ambiguity and Market Failure*, 7 J. RISK UNCERTAINTY, 71, 71 (1993).

[70] *Id*. at 75.

[71] *Id*.

[72] *Id*. at 72.

[73] *Id*.

[74] *See also* CBD Secretariat 2006, *supra* note 9, at 4.

[75] In this situation adverse selection and the well-known market for lemons would emerge. *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q. J. ECON. 488, 489 (1970). It also applied to insurance. *See* Priest, *supra* note 37.

longer exposed to risk since it has been shifted to the insurer.[76] In order for a risk to be insurable, insurers need to ensure that their policies are sufficiently differentiated for risks.[77] This practice would result in fully distinguishing between the various risk types so that lower risk is rewarded with a lower premium.[78] This would allow insurers to remedy adverse selection. Insurers could also impose policy conditions, such as experience rating, to deal with moral hazard. Without the required differentiation and appropriate policy conditions, adverse selection and moral hazard could undermine insurability.[79] Risk differentiation is easier with first-party insurance policies than with third-party insurance.[80] Under first-party insurance, the insurer can know exactly who the insured person is and, therefore, may have a better idea of the risk.[81] This is in contrast to a third-party situation, where a range of potential third parties could incur damage, and there may thus be more uncertainty.[82]

For so-called catastrophic risks (low probability of very large damage), insurers would need to take special measures, such as pooling by insurers, co-insurance, or re-insurance.[83] An important condition on the supply side is, therefore, that there is sufficient capacity to deal with the catastrophic risk.[84] Capacity refers to the need to have sufficient funds available to compensate a victim for the damage once an accident occurs.[85] Especially for relatively new risks (like LMOs), there may be a relatively small number of insurers willing to offer sufficient cover at competitive prices.[86] Not only demand but also sufficient supply is, therefore, a crucial condition of insurability.

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[76] Steven Shavell, *On Moral Hazard and Insurance*, 93 Q. J. ECON. 541, 541 (1979).

[77] Priest, *supra* note 37, at 1541.

[78] *Id*.

[79] Koch, *supra* note 14, at 615. The insurer should tailor the policies according to the various aspects of the risk, ideally with respect to each insured.

[80] Priest, *supra* note 37, at 1556.

[81] *Id*. at 1557.

[82] *See* Priest, *supra* note 37, at 1554–57.

[83] Pooling by insurers is a technique whereby insurers pool their resources together on a non-competitive basis in order to be able to provide higher capacity (higher amounts of coverage). Pooling is done for an entire category of risks, such as for example nuclear damage or environmental liability. Co-insurance consists of insurers cooperating to cover one larger risk by each providing a part of the coverage (e.g., four insurers each covering twenty-five percent) for this one particular project. Reinsurance is insurance coverage provided by a reinsurer to an insurance company. *See* FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS, *supra* note 68, at 88–106.

[84] *See id*.

[85] *Id*.

[86] *Id*. at 222–25.

3. Practice

There are diverging messages about the availability of insurance to cover LMO-related damage. In a comparative overview, Bernhard Koch held, in 2008, that neither first-party nor third-party cover for LMO-related damage would be available.[87] Other reports have also indicated that insurance companies in EU Member States would decline to insure against any damage caused by LMOs.[88] Examples of insurance policies excluding LMO-related damage are provided in Annex 1.

More recent reports refer to particular insurances that would not explicitly exclude LMOs.[89] There are a few reports indicating that some insurers, jointly with operators and policymakers, are trying to develop insurance products that could, under particular conditions, cover LMO-related damage. For example, in the United States, an insurance product for genetic damage to organic crops was proposed in a report by the Department of Agriculture's advisory committee on biotechnology.[90] Another recent study conditionally proposes crop insurance policies that may respond to some potential LMO-related damage.[91] A farm insurance program in the United States in 2016 provided multiple coverages for a wide variety of property types, where the use of LMOs was not explicitly excluded.[92] A note of caution applies to these particular examples as they may be outside the type of damage as defined in the NKLSP.

Also, a large reinsurer has developed the *Biodiversity and Ecosystem Services* (BES) index that could assist insurers in developing policies that cover damage to biodiversity.[93] The primary goal was to make sure there is a better

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[87] Koch, *supra* note 14, at 617–20.

[88] Gensch. . .den nicht versichert Bauernstimme 14 (01/2004); Genethischer-Informationsdienst 160 (10/2003), at 34.

[89] KEVIN POLL, OVERVIEW OF ISO'S NEW FARM PROGRAM - IRMI AGRICON (2016), https://www.irmi.com/docs/default-source/afis-handouts/overview-of-isos-new-farm-insurance-program.pdf?sfvrsn=14.

[90] USDA ADVISORY COMMITTEE ON BIOTECHNOLOGY AND 21ST CENTURY AGRICULTURE (AC21), ENHANCING COEXISTENCE: A REPORT OF THE AC21 TO THE SECRETARY OF AGRICULTURE (2012), https://www.usda.gov/sites/default/files/documents/ac21_report-enhancing-coexistence.pdf (last visited May 20, 2022). It is, however, unknown whether that proposal has been taken up by the market. This proposal is, however, not directly applicable to damage to biodiversity related to transboundary movements of LMOs.

[91] Roberts, *supra* note 18.

[92] POLL, *supra* note 89; CHRIS BERRY & ZACHARY MOORE, UTILIZING A FARM OWNERS' INSURANCE POLICY TO MANAGE RISKS TO FARM PROPERTY (2015), https://farmanswers.org/Library/OpenItem/5345.

[93] Press Release, Christian Mumenthaler, Group CEO, Swiss Re, A Fifth of Countries Worldwide at Risk from Ecosystem Collapse as Biodiversity Declines, Reveals Pioneering Swiss Re Index (Sept. 23, 2020), (available at https://www.swissre.com/media/news-releases/nr-20200923-biodiversity-and-ecosystems-

understanding of biodiversity and ecosystem service-related risks worldwide so that those risks can be calculated in business decisions and to make it possible for insurers to calculate premiums.[94]

Although more recent developments indicate at least an increased interest in developing insurance for some form of LMO-related damage, generally, there are still important limitations.[95] Most of the limitations are related to the specific features of LMOs. As a result, many argue that the basic conditions of insurability, mentioned in the previous subsection, are not met or not entirely met.[96] Setting insurance premiums would be difficult as the quantum of likely claims would be hard to estimate in advance. The result of insurers considering LMO-related damage not meeting the requirements of insurability is that many policies largely exclude LMO-related damage.[97]

One important reason often mentioned for the exclusion of liability for LMO-related damage is that there would be too much uncertainty concerning the scope of liability for LMOs.[98] An important condition for insurers to cover third-party liability would, therefore, be that a causal relationship is still required between the damage suffered and the presence of LMOs.[99]

It is also striking that insurance policies usually generally exclude all LMO-related damage and not just risk or damage to biodiversity (see Annex I). This is notable as the intrinsic difficulty of insuring LMO-related damage is probably

services.html) ("There is a clear need to assess the state of ecosystems so that the global community can minimize further negative impact on economies across the world. This important piece of work provides a data-driven foundation for understanding the economic risks of deteriorating biodiversity and ecosystems. In turn, we can inform governmental decision-making to help improve ecosystem restoration and preservation. We can also support corporations and investors as they fortify themselves against environmental shocks. Armed with this information, we can also ensure the provision of stronger sustainable insurance services.").

94 *Id*.

95 S*ee generally* CBD Secretariat 2006, *supra* note 9, at 2–5, Annex B; *The Insurability of Ecological Damage*, EDIE NEWSROOM (Mar. 1, 2004), https://www.edie.net/the-insurability-of-ecological-damage-2/.

96 Koch, *supra* note 14, at 616–17; Michael J. Davenport, *Genetically Modified Plants and Foods-Brave New World or Brave New Headache for Insurers*, 35 BRIEF 56, 61 (2005); Ebert & Lahnstein, *supra* note 42, at 577.

97 Ebert & Lahnstein, *supra* note 42, at 577–78; Koch, *supra* note 14, at 616–17.

98 Ebert & Lahnstein, *supra* note 42, at 577–78; Koch, *supra* note 14, at 616–17.

99 Shifting the risk of causal uncertainty to an operator and his insurer has generally been considered a cause of uninsurability. *See* FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS, *supra* note 68, at 125–26; Martin T. Katzman, *Pollution Liability Insurance and Catastrophic Environmental Risk*, 55 J. RISK & INS. 75, 89–90 (1988). The Supplementary Protocol also requires a causal link to be established "between the damage and the living modified organism in question in accordance with domestic law." NKLSP, *supra* note 2, art. 4.

different depending on the type of damage to be insured. For example, the information on damage resulting from co-mingling should be predictable; therefore, one can understand that some careful steps towards covering those risks are made, while damage to biodiversity might be much harder to cover.

4. Analysis

If all of the previously mentioned conditions of insurability could be met, insurance can, theoretically, provide compensation for both damage to the insured (first-party cover) and damage to victims (third-party cover). The entity providing this insurance is the insurance company, complying with applicable regulatory requirements. Insurers are professionals in covering risks and handling claims.[100] Insurers themselves can rely on reinsurance by one or more of the many reinsurers in the world.

Insurance can, in theory, provide financial security for many risks. However, in the case of damage to biodiversity caused by LMOs, it may not be easy to satisfy the conditions of insurability. The various uncertainties, including the scope and scale of damage and the applicability of and variation in national liability rules, would complicate the calculation of premiums. Moreover, the number of players on the market that demand insurance may be limited; as a result the large amount needed for insurability may be lacking as well. Insurance can theoretically have a negative effect on the incentives to invest in prevention as it inevitably creates a moral hazard risk. That risk could be remedied if insurers can apply appropriate instruments of risk differentiation. Risk differentiation is needed to remedy adverse selection and moral hazard. That, however, assumes that insurers have information on the various types of insured and the various activities (and associated risks of these activities) the insured are engaged in. To the extent that information is lacking, moral hazard would not be adequately addressed; in that case, insurance might negatively affect incentives for prevention. Finally, if insurers were already willing to provide coverage (e.g., by including a risk premium to deal with insurer ambiguity), it is not certain that the coverage will correspond with demand. Moreover, the insurance cover provided can be limited, possibly resulting in the need for additional instruments to cover the amount of the damage not covered by insurance.

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[100] Koch, *supra* note 14, at 616.

5. Role of Government

The adequacy of compensation through insurance depends on the capacity that can be provided on the market by insurers and (re)insurers. There are, however, various steps that the government could take to stimulate the insurability of LMO-related risks. First, the government could clarify the liability regime for LMO-related risks in order to provide more certainty concerning the scope of liability. The regulator could, for example, determine whether a strict or a fault-based liability applies and what type of response measures the operator should undertake. This could provide more insights into the potential extent of the damage. Second, the government could set clear standards with respect to the liability regime to facilitate its insurability. For example, the insurability of damage resulting from offshore oil and gas activities has considerably increased over the years as a result of private and public safety standards.[101] Clear standards concerning good professional practice for LMOs could facilitate the insurability of LMO-related damage.[102] The Cartagena Protocol sets out a framework for assessing the risks of LMOs to biodiversity, with its Annex III establishing a framework for risk management. Further guidance has also been developed.[103] This information could be used by the insurance industry to understand the practices in this area and to inform the development of insurance products.

Third, the government could facilitate insurability by limiting the financial scope of liability by providing a financial cap on the liability. This is explicitly provided as an option in Article 8 of the NKLSP.[104] A statutory financial cap could facilitate insurability by providing an indication to insurers as to their maximum exposure. However, for insurability, a statutory limitation on the liability is not strictly needed. Insurers themselves could provide a limit on their financial exposure in the policy conditions.

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[101] Michael Faure & Hui Wang, *Potential of Financial and Insurance Instruments to Cover Liability Following a Major Offshore Accident*, *in* CIVIL LIABILITY AND FINANCIAL SECURITY FOR OFFSHORE OIL AND GAS ACTIVITIES 266, 269 (2017).

[102] Ebert & Lahnstein, *supra* note 42, at 577–78; Odile J Lim Tung, *Transboundary Movements of Genetically Modified Organisms and the Cartagena Protocol: Key Issues and Concerns*, 17 POTCHEFSTROOM ELEC. L.J. 1739–87 (2017).

[103] Convention on Biological Diversity, *Guidance on Risk Assessment of Living Modific Organisms and Monitoring in the Context of Risk Assessment,* UNEP/CBD/BS/COP-MOP/8/8/Add.1 (Sept. 14, 2016), https://www.cbd.int/doc/meetings/bs/mop-08/official/bs-mop-08-08-add1-en.pdf.

[104] NKLSP, *supra* note 2, art. 8 ("[p]arties may provide, in their domestic law, for financial limits for the recovery of costs and expenses related to response measures".).

Often, a financial limit on liability is introduced in connection with the introduction of mandatory liability insurance.[105] However, the legislator could impose a duty to seek financial security up to a particular amount but keep the liability itself unlimited.[106] A classic example of this is the case of motor vehicle insurance. In many legal systems, there is a duty to have third-party liability insurance up to an amount determined by the legislator, but the liability of the driver has often remained unlimited. The major disadvantage of a financial cap on liability is that it can negatively affect the incentives for prevention if operators are not exposed to the full losses arising from the damage they may cause.[107]

One final role for the government might be related to the potentially catastrophic nature of the loss. Damage of a high magnitude may not be insurable to its full extent, not even on the reinsurance market. One can increasingly notice that in those cases, the government sometimes intervenes as a reinsurer of last resort, thus stimulating insurance cover.[108] This approach is now often employed with natural hazards as well as with insurance of terrorism (see **Error! Reference source not found.** below).[109] To the extent that LMO-related damage might be catastrophic and insurance or reinsurance cover for catastrophic damage could not be acquired, the government may decide to take on the role of the financial security provider.

C. Self-Insurance

1. Description

Self-insurance is a term often used to refer to corporations using their own assets to cover future damage.[110] In a technical sense, it is therefore not to be considered as "insurance" as there is no risk-spreading, no risk-distribution, and no loss-spreading after an accident happens.[111] It is a mechanism where

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105 *See* discussion *infra* Section III.G.

106 FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS, *supra* note 68, at 97–106.

107 *Id.* at 97–101.

108 *See also* Véronique Bruggeman, Michael Faure & Karine Fiore, *The Government as Reinsurer of Catastrophe Risks?*, 35 GENEVA PAPERS RISK & INS. ISSUES & PRAC. 369, 369–90 (2010); Véronique Bruggeman, Michael Faure & Tobias Heldt, *Insurance Against Catastrophe: Government Stimulation of Insurance Markets for Catastrophic Events*, DUKE ENV'T L. & POL'Y F. 185, 185–241 (2012).

109 *See, e.g.*, Bruggeman, Faure & Fiore, *supra* note 108; Bruggeman, Faure & Heldt, *supra* note 108.

110 Patrick L. Brockett, Samuel H. Cox & Robert C. Witt, *Self-Insurance and the Probability of Financial Regret*, 51 J. RISK & INS. 720, 720–29 (1984).

111 FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS, *supra* note 68.

operators use their balance sheet to guarantee payment for large damage.[112] Using reserves does allow risk-spreading in time, but not between various parties exposed to risk. A related notion is the so-called "captive," which is an insurance company that is created by an operator.[113] It is effectively an insurance company owned by one particular operator. Self-insurance can be used especially by large operators with substantial capital who would have no need to shift risks to a third party (like an insurance company), which would also incur costs.

2. Conditions

The only essential condition for self-insurance to function is that the operator must have sufficient reserves available to cover future damage—either its own damage or the damages that would have to be paid to a third-party victim. The ability of an operator to self-insure, therefore, depends on the size of the estimated risk and also on the amount of its available assets.

3. Practice

There is no specific information on the extent to which internal reserves are mentioned as an option to cover LMO-related damage. However, the mere fact that alternatives, like (re)insurance, are almost unavailable for LMO-related damage may imply that many actors along the supply chain will use their internal reserves for the simple reason that they may not have any other alternatives.

In the context of the supply chain of LMOs, one can imagine that it could especially be the larger developers of LMOs with substantial assets that rely on self-insurance but not smaller and medium-sized companies (e.g., importers of LMOs) or smallholders like farmers or other end-users.[114] The Compact: A Contractual Mechanism for Response in the Event of Damage to Biological Diversity Caused by the Release of a Living Modified Organism (Compact) addresses an interesting example that damage caused by LMOs to biodiversity is, to some extent, akin to self-insurance.

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[112] *Id.*

[113] *Id.*

[114] From a normative perspective, it should only be the larger stakeholders with substantial assets that should use self-insurance; in practice, however, smallholders may be forced to self-insure for the simple reason that they could not access other financial security mechanisms. It is not desirable that those thinly capitalized stakeholders to self-insure as there could be a substantial risk of insolvency.

The Compact is a contractual agreement among some of the largest agricultural LMO developers (e.g., BASF, Bayer CropScience, Corteva, and Syngenta). Through the Compact, the developers (Members) agree to binding arbitration for settling claims for damage to biological diversity caused by the release of an LMO by the respective company.[115] The Compact determines conditions under which payment will be provided and only allows a State to file a claim. States that opt for binding arbitration under the Compact are required to ensure that the Compact Member is not subject to multiple recoveries for the same incident of damage under both the Compact and a State's civil liability system. The State must show that an LMO produced by a Compact Member caused a measurable, significant, and adverse change to a species or ecosystem in that country. States, therefore, become third-party beneficiaries under the Compact.[116] Each Compact Member guarantees that it will individually cover damage caused by the LMO it produced up to specific financial limits. The Compact requires that, upon determination of the Member's response cost, the Compact Member will demonstrate financial security through self-insurance, commercial insurance, banker's draft, or another form of financial security. Members are also required to encourage the development of commercial insurance for Response obligations.[117] The literature mentions that the reluctance of the insurance industry to provide cover for LMO-related damage to biodiversity was one of the reasons for the biotechnology industry to establish the Compact.[118] The Compact itself, however, does not resolve the lack of insurance availability. The Compact explains that its terms:

> [A]re also intended to encourage the development of commercial insurance for the cost of Response for Damage to Biological Diversity should it be required under the terms and conditions of the Compact.

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[115] INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS (ISAAA), THE COMPACT: A CONTRACTUAL MECHANISM FOR RESPONSE IN THE EVENT OF DAMAGE TO BIOLOGICAL DIVERSITY CAUSED BY THE RELEASE OF A LIVING MODIFIED ORGANISM (2010) [hereinafter THE COMPACT], https://www.isaaa.org/workshop/2012-01-10-bangkok/download/liability_and_redress/Compact.pdf.

[116] *See also* Carrato J. Thomas, John Barkett, & Phil Goldberg, *The Industry's Compact and Its Implications for the Supplementary Protocol*, *in* INTERNATIONAL LIABILITY REGIME FOR BIODIVERSITY DAMAGE: THE NAGOYA–KUALA LUMPUR SUPPLEMENTARY PROTOCOL 236–57 (2014); Nijar, *supra* note 4, at 284–85; Telesetsky, *supra* note 33.

[117] THE COMPACT, *supra* note 115, pmbl. 1.C.

[118] *See also* Thijs F.M. Etty, *7 Biotechnology*, 22 Y.B. INT'L ENV'T L. 318, 321 (2011); Vasilka Sancin & Wen Xiang, *International Liability and Redress for Genetically Modified Organisms and Challenge for China's Biosafety Regulation*, *in* INTERNATIONAL ENVIRONMENTAL LAW: CONTEMPORARY CONCERNS AND CHALLENGES 581, 581–600 (2012); AMANDINE BLED, PRIVATIZING ANTICIPATORY GOVERNANCE? THE BIOTECH INDUSTRY GLOBAL COMPACT INITIATIVE FOR LIABILITY AND REDRESS UNDER THE CARTAGENA PROTOCOL ON BIOSAFETY 49 (2009).

> The availability of commercial insurance will enhance a Member's ability to demonstrate the requisite financial capacity to Respond. Its availability should also create the opportunity and incentive for any entity that works with LMOs to join the Compact, thereby providing States assurance of access to Response. The availability of commercial insurance will facilitate broad and open membership, one of the core goals of the Compact.[119]

According to the Compact, each Member is individually liable for the damage caused by the LMO it developed, but Members do share the operating costs of the Compact on a proportional basis.[120] The Compact is thus a commitment of each Member that it will respond to damages caused to biodiversity by the LMOs it developed.

Internal reserves are also used in relation to other types of environmental damage, more particularly in the energy sector.[121] A typical example is the Offshore Pollution Liability Association (OPOL), where self-insurance is used, among many alternative financial security options available. Membership in OPOL is mandatory for offshore operators in the United Kingdom who wish to obtain a license for oil drilling.[122] Operators are liable for the damage caused as a result of oil drilling and need to provide financial security. Under OPOL, the operator of an offshore facility shall reimburse the costs of remedial measures and pay compensation for pollution damage up to an overall maximum of $250 million (USD). To cover these obligations, the operator has to comply with the rules for the establishment of financial responsibility. One way of proving financial responsibility is qualifying as a self-insurer by providing a financial statement meeting certain strict criteria.[123] For example, an operator can qualify as a self-insurer under OPOL only if it has a high credit rating from certain credit rating agencies.[124] Each operator that is a party to OPOL must provide satisfactory evidence of its ability to meet any liability under OPOL, which is

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[119] THE COMPACT, *supra* note 115, sec. C.

[120] *Id.*

[121] Self-insurance is allowed in various jurisdictions for nuclear power plants, oil and gas companies and coalmine operators. *See* Mackie & Besco, *supra* note 20, at 10575; Colin Mackie & Valerie Fogleman, *Self-Insuring Environmental Liabilities: A Residual Risk-Bearer's Perspective*, 16 J. CORP. L. STUD. 293, 298 (2016).

[122] Sam Dunkley & Samantha Key, *Oil & Gas: Assignment of an Offshore Licence*, PRACTICAL L. UK (Sept. 2018).

[123] Peter Cameron, *Liability for Catastrophic Risk in the Oil and Gas Industry*, 6 INT'L ENERGY L. REV. 207–19 (2012).

[124] An A or higher rating from Standard & Poor's, A minus or higher from A.M. Best or an A3 or higher from Moody's.

then verified by OPOL.[125] Therefore, OPOL shows that, on the condition that stringent rules apply to control whether a particular operator can qualify as a self-insurer, self-insurance could also function in a model of mandatory financial security.[126]

For example, major oil companies could use their own reserves as financial security to cover damage related to offshore drilling. As these oil-producing companies consider all other alternatives (including insurance) relatively costly, they prefer self-insurance as it does not lead to additional costs unless the damage occurs.[127] Major oil and gas companies, for example, largely use self-insurance to hedge offshore-related risks.[128] Even smaller operators may use self-insurance as so-called retention (or deductible), where coverage would only be required for amounts beyond the carrying power of the particular operator.[129] Self-insurance can also be used for operators of a geological storage site for carbon dioxide according to Guidance Document 4 implementing E.U. Directive 2009/31/EC on the geological storage of carbon dioxide.[130] Self-insurance is additionally mentioned in the U.S. EPA Financial Responsibility Guidance Document with respect to geological sequestration of carbon dioxide.[131]

4. Analysis

Self-insurance is usually used by entities with sufficient assets that do not fear that the scope of the damage may lead them into insolvency. These entities are generally larger corporations that have no risk-aversion for cover against either their own risk or the fear of liability for damage suffered by third parties.

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[125] *See also* Michael Faure & Hui Wang, *Compensating Victims of a European Deepwater Horizon Accident: OPOL Revisited*, 62 MARINE POL'Y 25, 25–36 (2015) [hereinafter Faure & Wang - *Compensating Victims*].

[126] *Id*.

[127] Michael Faure & Hui Wang, *The Use of Financial Market Instruments to Cover Liability Following a Major Offshore Accident*, *in* CIVIL LIABILITY AND FINANCIAL SECURITY FOR OFFSHORE OIL AND GAS ACTIVITIES 236, 238–39 (Michael Faure ed., 2016).

[128] *Id.* at 238.

[129] *Id*. at 240.

[130] It is, however, considered one of the riskiest options because there is no protection provided against claims of creditors. The document, therefore, holds that "[c]ertainty also depends on stringency of required financial tests." *Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide: Guidance Document 4, Article 19 Financial Security & Article 20 Financial Mechanism*, at 27 (June 15, 2012) [hereinafter *Implementation of Directive 2009/31/EC*], https://data.europa.eu/doi/10.2834/99563.

[131] "Self-insurance allows the owner or operator to submit financial statements and other information to prove that they are likely to remain in operation, based on indicators of the economic health of the organization, and that they will be able to complete all required GS activities" *See* FAURE & PARTAIN, *supra* note 10, at 169–70.

These are entities with balance sheets comparable to other security providers (e.g., insurance companies) and for whom shifting risks to a third party (like an insurer) would consequently only lead to additional costs and not sufficient benefits.

The advantage of self-insurance from the industry's perspective is that it is a relatively low-cost solution; operators themselves can provide payment guarantees for future damage and do not have to transfer risks to an insurance company, which may create additional costs. Self-insurance usually does not create any costs for the operator as it allows the operator to use its balance sheet to show financial security. There is no need to immobilize capital by, for example, requiring money to be put on a separate balance sheet. The operator is held to transfer the reserves from the balance to cash only when the accident occurs.[132] Self-insurance does not involve a moral hazard[133] risk, as operators will still remain exposed to the risk and liability (assuming the ability of the operator to compensate for the damage, in other words, full solvency).

There are also disadvantages of self-insurance, the most important being that it is not necessarily a guarantee against insolvency. The reason is that (1) the reserves may no longer be available when the damage occurs and the money is needed, and (2) there may be other creditors that have priority in the case of bankruptcy (e.g., the tax authorities) as the result of which there might not be sufficient money left for the restoration of the environment. Self-insurance can also lead to the externalization of risk (shifting costs to society) in the case of insolvency.[134] If the operator is insolvent and there is no money available for environmental restoration, it would mean either the state pays (and thus the taxpayers) or the damaged environment is not restored. In both cases, the risk is not internalized by the operator but externalized to society at large. Self-insurance can hence only be considered effective financial security if guarantees can be provided so that (1) sufficient reserves are set aside in the first place and (2) those reserves will actually be used for the potential damage for which they were earmarked.[135] If those conditions cannot be met, there is a danger that self-

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[132] This can obviously lead to the need to sell assets (like real estate) at a lower price to provide the necessary cash.

[133] *See supra* Section III.A.2.

[134] Most environmental legal literature is extremely critical of, what is called "self-bonding", arguing that it can pose "a systemic risk to the environment and taxpayers." Jason Malone & Tim Winslow, *Financial Assurance: Environmental Protection as a Cost of Doing Business*, 93 NOTRE DAME L. Rev. 1, 4 (2018); Mackie & Fogleman, *supra* note 121, at 296; Mackie & Besco, *supra* note 20, at 10583–85.

[135] As will be explained in the next subsection, this is precisely what should be guaranteed in regulation.

insurance may not be a mechanism that provides adequate financial security; in the case of insolvency, the trustee in bankruptcy would collect the assets, and the money would not be available to compensate for LMO-related damage.[136]

As far as compensation is concerned, self-insurance may work as a first-party cover but is more problematic for damage to a third party. Self-insurance may create positive incentives for prevention, as the operators' own assets are at risk (and thus, no moral hazard arises). But that relies on the heavy assumption that no insolvency risk would arise.

In theory, self-insurance should only be used as financial security by well-capitalized, larger stakeholders. In practice, however, thinly capitalized smaller holders also self-insure, not because this would be desirable, but simply because they may not have access to other financial security mechanisms. Self-insurance by thinly capitalized smaller holders may not even constitute self-insurance; should damage arise, the risk of insolvency is high, and so any reserves may well go to other creditors, leaving no funds available for compensating or redressing the damage.

5. Role of Government

There is some debate over whether self-insurance can be accepted as an option in a situation where financial security is mandatory. If self-insurance were not accepted by the regulator, the mandatory financial cover would force operators to purchase costly insurance even though the insurance may provide little additional security for large operators. Yet, accepting self-insurance runs the risk of not having compensation available once an accident happens. Self-insurance, therefore, creates an important role for the government in verifying that operators are adequately capitalized and have sufficient assets. The use of self-insurance in the context of mandatory financial guarantees, therefore, requires smart regulation. If the regulator were to introduce a mandatory requirement for financial guarantees, the possibility to demonstrate financial security via self-insurance should be provided for. Thus, the danger that major operators would be forced to shift the risk to an insurance company can be avoided, even when, for example, the credit rating of the operator would be higher than that of the insurance company.[137]

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[136] When an operator self-bonds and files for bankruptcy, there is often little to no funds for reclamation. *See* Malone & Winslow, *supra* note 134, at 4; Mackie & Besco, *supra* note 20, at 10575.

[137] FAURE & PARTAIN, *supra* note 10, at 169.

But if, in that particular case, self-insurance is used as one of the mechanisms to show proof of solvency, there should be a guarantee that the money set aside (via reserves) can only be used for LMO-related damage and the self-insurance offered by the operator is adequately controlled. The example of OPOL is interesting in that respect. Of course, as in the case of OPOL, showing self-insurance does not mean that the capital reserved should necessarily be immobilized as long as it can be made available to cover damage when the damage occurs. Self-insurance works in this particular case as there is *de facto* no risk of insolvency due to the substantial assets and high credit ratings of the operators. The operator can, therefore, still freely use the funds that are set aside to cover future damage. Another example is the accident with the Deepwater Horizon in the Gulf of Mexico; British Petroleum (BP) was able to allot $20 billion (USD) solely based on self-insurance.[138]

D. Risk Pooling

1. Description

Risk pooling is a model where operators or, more generally, persons exposed to a particular risk mutually agree to cover each other's losses via a risk sharing or a risk distribution agreement.[139] Suppose that one hundred operators each face a one percent probability of being exposed to a risk (e.g., losing a crop as a result of a storm), which could create a loss of €100.000 during a period of, say, one year. Risk aversion might inhibit the operators from engaging in the activity altogether as the land may be the only asset they possess that would be exposed to the relatively high risk (one percent) of a total loss. The operators in this example could mutually share each other's losses by agreeing to an *ex-ante* that each pays 1.000.[140] By taking the certain loss of 1.000, operators have traded

[138] Colin McDonell, *The Gulf Coast Claims Facility and the Deepwater Horizon Litigation: Judicial Regulation of Private Compensation Schemes*, 64 STAN. L. REV. 765 (2012). Shortly after the accident, BP entered into negotiations with the U.S. Government that resulted in BP establishing the Gulf Coast Claims Facility (GCCF), a $20 billion (USD) fund to settle claims arising from the Deepwater Horizon Oil Spill. This fund was set aside for natural resource damages, state and local response costs, and individual compensation but could not be used for fines or penalties. The GCCF was a private compensation scheme funded by BP. *Id*.

[139] *Risk Pooling: How Health Insurance in the Individual Market Works*, AM. ACAD. ACTUARIES, https://www.actuary.org/content/risk-pooling-how-health-insurance-individual-market-works-0 (last visited Jan. 21, 2023).

[140] Note that in this example the 1.000 is exactly the probability (1%) x damage (100.000). In other words, the actuarially fair premium if it were insurance.

risk and removed risk aversion. Once the risk materializes, 100 x 1.000 = 100.000 is available to cover the loss.[141]

The essence of such a risk sharing agreement is that there is no shifting of risk to a third party but that those exposed to the risk directly and mutually share each other's losses. As the likelihood that the pool has to pay out depends upon the safety efforts of all members, prevention becomes a collective responsibility. Differently from the example where the risk was exogenous and created by a natural hazard, risk pooling could also be used where operators have an influence on the risk that damage occurs, for example, tanker owners pooling the risk of liability for oil pollution damage. In that example, the likelihood that the pool has to pay depends to some extent on the safety measures employed by each tanker owner to reduce the risk. This gives the members of the pool strong incentives towards mutual monitoring of safety. In order to prevent members in the pool from free riding, managers of the pool will strictly check that the pool members do not take unreasonable risks. If one pool member creates higher risks than others, its contribution to the pool would increase to account for this higher risk. This increase gives the particular member an incentive for prevention. If the risks created by one particular member are very high (and there would thus be heterogeneity between the pool members), it is most likely that the member would be excluded from the pool to exclude the risk of free riding on the other pool members.

If risk sharing agreements and pooling by insurers are compared, this pooling of insurers should be carefully distinguished from the risk sharing agreements between operators where, in principle, no insurance company intervenes. As the same word "pooling" is used to cover both concepts that may be confusing.[142] The concept of "pooling" is used for two mechanisms that should be carefully distinguished. On the one hand, there is a pooling of risks by insurance companies. In that case, insurance companies exclude competition to deal with a particular risk and bring all capacities together in one pool. It implies that, for a particular risk, usually within one country, insurance companies pool the capacity into, for example, an environmental pool. The effect is that, through this pooling by insurers, a much larger capacity can be generated than when insurers would offer coverage separately. The individual insured can only insure the risk with the particular pool and no longer with the separate insurers. The

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[141] *See* Göran Skogh, *Risk-sharing Institutions for Unpredictable Losses*, J. INST'L & THEORETICAL ECON. 505, 505–15 (1999).

[142] *See also* FAURE & HARTLIEF - INSURANCE AND EXPANDING SYSTEMIC RISKS, *supra* note 68, at 90–92.

pool, therefore, effectively functions as a monopoly and is, for that reason, in many jurisdictions scrutinized by competition authorities. Pools are often created for catastrophic risks, such as nuclear risk. Nuclear power plants can, therefore, only obtain insurance from those pools. In some countries, some environmental risks are pooled, and those risks are then covered by national insurance pools. This is, for example, the case with the environmental pool in the Netherlands and Assurpol in France.

2. Conditions

Risk pooling between operators generally requires that the administrative costs of creating and operating the pool are not too large. This implies that, for example, the number of participants should be relatively limited in order to keep mutual monitoring possible. For this reason, risk-sharing agreements typically emerge between a relatively small number of participants. This contrasts with insurance which, as explained above, needs a large number of insured to be feasible.[143] Risk pooling generally requires an orchestrator to take the initiative to create the pool and some person or institution to manage the pool. The members or the institution should possess information enabling them to engage in mutual monitoring. Given the specific conditions needed for risk pooling arrangements, pools often emerge with rather homogeneous risks.

Note, however, different from insurance, statistical information on the probability that a particular risk would occur is not strictly necessary as an *ex-ante* calculation, and payment of a premium may not be required. An *ex-ante* agreement on the *ex-post* sharing of losses arising from damage is sufficient. This explains why risk pooling may be relatively attractive for new risks where insurers may lack the statistical information needed to calculate premiums.[144] Even though in a risk-sharing agreement, the *ex-ante* payment of a contribution is not strictly necessary, in practice, there will often be a particular contribution that the members do pay to the pool. But the important point is the flexibility of the arrangement. This implies that if no damage occurred in one year, in the subsequent year, a lower contribution or even no contribution at all could be charged.

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143 *See supra* Section III.B.

144 *See also* Jing Liu & Michael Faure, *Risk-Sharing Agreements to Cover Environmental Damage: Theory and Practice*, 18 INT'L. ENV'T. AGREEMENT: POL. L. ECON. 255, 255–73 (2018).

3. Practice

No true risk-sharing arrangement, as described in the previous sections, exists for LMO-related damage, but a number of hybrid variants have been developed. The main characteristics of those arrangements that make them different from the typical risk-sharing arrangement will be described in Section III.G. In addition, in several other domains, risk-sharing agreements have emerged to cover environmental risks, or attempts have been undertaken to develop them. Those may provide insights into the likely development of risk-sharing agreements for LMO-related risks.

Some agricultural insurance (i.e., first-party cover providing farmers with financial protection against damage from natural events such as drought, hail, wind, etc.) are constructed as risk-pooling schemes.[145] To the extent that those schemes do not exclude damage related to LMOs, they could be considered as an implicit LMO risk-pooling scheme.[146] It is, however, unlikely that those schemes would cover the type of damage envisaged by the NKLSP. The literature mentions *ex-ante* contractual solutions between GM and non-GM farmers to deal with the admixture problems.[147] Although these contractual arrangements may provide for an *ex-ante* arrangement of potential damage (and, in that sense, also for financial security), there is no risk-spreading, and formally, those contractual solutions can, therefore, not be qualified as risk-pooling.

At the domestic level, there are several compensation funds, or *ad hoc* solutions, most of which will be discussed in the next section related to funding.[148] Those models sometimes foresee a payment by operators meant to cover potential damage, but in those cases, there is no voluntary risk-sharing, simply a levy that has to be paid on a statutory basis.[149]

In several other domains, risk-sharing agreements have emerged to cover environmental risks. The most prominent example is the risk-sharing in the

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[145] Agricultural insurances may show a wide variety of governance models. In some cases, farmers associations that stimulate (or subsidize) the creation of risk-sharing pools; in other cases, mutual insurances (in which farmers associations may equally participate) can provide cover. In practice, one can, therefore, also observe mixes between risk-sharing and insurance. *See also* discussion *infra* Section III.G.

[146] Any explicit trace of those in the literature has not been seen, but it can certainly not be excluded that they do exist.

[147] Koch, *supra* note 14, at 633.

[148] *See generally id*. at 629–34.

[149] For example, a compensation model developed in Denmark. This model involves all stakeholders dealing with LMOs, but there is no sharing of risk. *See also* Koch, *supra* note 14, at 633–34; *infra* Section III.E.3.

maritime sector provided by the so-called Protection and Indemnity Clubs (P&I Clubs). P&I Clubs are mutual insurance associations established by ship owners and charterers to cover third-party liabilities related to the use and operation of ships.[150] The several P&I Clubs have joined their forces into an international group of P&I Clubs. They play an important role, for example, in covering liability for oil pollution damage created by tankers.[151] The P&I Clubs monitor the preventive efforts of all individual members and will, for example, exclude the (more risky) so-called "single-hull tankers."[152] At the beginning of a year, a call is made requiring a contribution (comparable to a premium for insurance) from the members. If, in a particular year, no accident happens for which the P&I Club needs to intervene, the contribution paid by the members can be reserved for the next year. Alternatively, if more accidents happen than expected, an additional call could be made.[153] The P&I Club can thus adapt contributions in a flexible manner.

Pools have also been created to cover damage related to nuclear risk,[154] such as damage resulting from offshore oil and gas drilling and, on a large scale, damage related to fisheries in China.[155] This damage relates *inter alia* to damage resulting from the destruction of ships (as a result of bad weather events) but also, for example, to natural disasters causing damage to aquaculture. The fishermen are members of the pool and can call for compensation if the specific conditions for which the pool was created were met. In that case, the Chinese government (both central and at the local level) plays a strong role in the establishment and workings of the various risk-sharing agreements.[156]

The cases where risk-sharing has failed or succeeded can provide information on the conditions for effective risk-sharing. There were risk-sharing pools for damage resulting from offshore drilling, but they never were a major success for the simple reason that large oil companies did not want to pool risks with smaller operators, as it would make major operators *de facto* the guarantors of smaller players.[157] The problem with offshore drilling risk was related to the

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[150] Norman J. Ronneberg Jr., *An Introduction to the Protection & (and) Indemnity Clubs and the Marine Insurance They Provide*, 3 U.S.F. MAR. L.J. 1 (1990).

[151] Liu & Faure, *supra* note 144, at 264–66.

[152] *Id.*

[153] *Id.*

[154] *Id.* at 267–69.

[155] Faure & Wang - *Compensating Victims*, *supra* note 125, at 261–62.

[156] *See* Minzhen Jiang & Michael Faure, *Risk-Sharing in the Context of Fishery Mutual Insurance: Learning from China*, 121 MARINE POL'Y 104191 (2020).

[157] Faure & Wang - *Compensating Victims*, *supra* note 125, at 261–62.

difference in the size of the various operators. This implies that a hypothetical risk-sharing scheme between operators of similar size, for example, between developers of LMOs, might work. On the contrary, a risk-sharing agreement between, for example, large developers and GM farmers might fail because the operators are too diverse.

Creating a risk-sharing scheme requires some entity to take the initiative and bring the parties together to create the risk pool. In some cases, where risk-sharing between fishermen would be a viable option to deal with risk, the risk-sharing scheme did not emerge because there was no orchestrator to take the initiative.[158]

In some cases, an outside trigger was the necessary catalyzer for the establishment of a risk-sharing agreement, for example, an accident that triggered others to establish a risk-sharing agreement aiming at the prevention and compensation of that damage. In practice, seeking financial security is often a regulatory duty that acts as the trigger to create a risk-sharing agreement.[159] The risk-sharing arrangement can then be used to meet the regulatory duty to seek financial security.[160]

4. Analysis

Risk-sharing between operators is a valuable financial security instrument as, on the one hand, it can provide incentives for prevention through mutual monitoring among the operators participating in the risk-sharing arrangement, and, on the other hand, it can provide compensation for damage. Moreover, risk sharing can, theoretically, have several advantages compared to insurance:

- Risk-sharing creates strong incentives for mutual monitoring, as a bad risk member can increase the likelihood that the pool will have to compensate.
- For highly technical and complicated (often new) risks, operators themselves may have better information (compared to insurers) on optimal preventive technologies, which they can reflect in a

[158] The absence of such an orchestrator was one of the reasons why the creation of a risk-sharing agreement that was attempted in Portugal (in the region of the Viggo River) between fishermen failed. *See* Schimon Grossmann & Michael Faure, *Conditions for Effective Risk Sharing Against Marine Pollution: The Case of the Ria de Vigo*, 2 ENV'T LIAB. 59, 59–69 (2016).

[159] FAURE & PARTAIN, *supra* note 10, at 177.

[160] Grossmann & Faure, *supra* note 158, at 67.

differentiation of the contribution to the pool (or excluding membership for bad risks).

- A risk-sharing agreement does not require actuarial information *ex-ante* on the probability of an accident and the scope of the damage, as no *ex-ante* premium must be fixed. *Ex-ante* information is only needed to establish the relative contribution of each member to the risk, but this does not necessarily have to be translated into a premium.
- Unlike insurance, when the risk would not emerge, no premiums are paid to an insurance company that are (at least in the view of the operator) "lost." If the risk for which the risk-sharing agreement is concluded does not emerge, the members of the risk-pooling scheme do not have to contribute.[161]

There are also particular limits of risk-sharing:

- Risk-sharing can only emerge when there is a relatively small number of members in the pool.
- Risks also have to be relatively homogeneous; there is otherwise a possibility for riskier operators to be excluded from the risk-pooling arrangement.

Risk-sharing agreements can potentially provide first-party compensation and third-party liability (e.g., the P&I Clubs for oil pollution). Since risk-sharing agreements are based on collective risk-sharing, there is a strong incentive towards mutual monitoring, and thus potentially exclude or at least seriously reduce the moral hazard risk. As participants in a risk pool are assumed to have good information on the types of risks the pool covers, the respective contributions to the pool can be aligned to the individual risk, thus reducing moral hazard much better than under insurance. Incentives for prevention could thus be optimal in a risk-sharing agreement. However, for risk-sharing arrangements to emerge and function, some very specific conditions, previously mentioned, need to be met.

5. Role of Government

While risk-sharing agreements are usually the result of private initiatives, governments can still play a role in facilitating the establishment of such agreements. Governments can require certain operators to provide financial

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[161] *See also* FAURE & PARTAIN, *supra* note 10, at 172.

security that may trigger the creation of a risk-sharing agreement among these operators.[162] An important condition for risk-sharing is that members are able to monitor other members—this can be facilitated through the creation of safety standards.[163] Accordingly, governments can also facilitate risk-sharing arrangements by setting such safety standards,[164] although these safety standards could also be created by private standard setting organizations. Finally, the government can also play an important role in stimulating the creation of a risk-sharing agreement by providing a subsidy on the contributions to be paid by the members in the pool. For example, in the Chinese fishing industry, risk-sharing agreements have emerged on a large scale, but this is, to an important extent, due to central and local governments that initiated the creation of risk pools and have, in some cases, also subsidized them.[165]

E. Fund

1. Description

A compensation fund is a mechanism that directly compensates the damage suffered by a particular victim.[166] In fund construction, the victim no longer addresses the liable injurer but seeks compensation from the fund.[167] The fund could be financed by the general taxpayer or through contributions from activities that potentially create the damage for which the fund was created. Some funds provide for the possibility of taking recourse against the liable injurer after first having compensated the victim.[168]

A compensation fund can take many different forms. The essence is that it is usually run by the government as an alternative to market-based solutions (such as insurance) or as an additional layer for compensation (in addition to liability and liability insurance). A compensation fund does not usually provide full compensation (as under an insurance scheme) but rather fixed, standardized amounts, which may be lower than the damage suffered by the victim.[169] There

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[162] *See infra* Section III.G.

[163] Liu & Faure, *supra* note 144, at 271.

[164] *See also supra* Section III.B.5.

[165] Jiang & Faure, *supra* note 156.

[166] Michael G. Faure & Ton Hartlief, C*ompensation Funds Versus Liability and Insurance for Remedying Environmental Damage*, 5 REV. EUR. CMTY. & INT'L ENV'T L. 321 (1996) [hereinafter Faure & Hartlief - *Compensation Funds*].

[167] *Id.*

[168] *Id.*

[169] *Id.*

may be different rationales for creating a compensation fund. In some cases, funds are established to compensate when no liable injurer can be identified (e.g., in the case of a natural disaster); in other cases, a fund may be created to provide speedy compensation to the victim (thus avoiding lengthy procedures before a court). Funds are also established to create an additional layer to the compensation provided through other mechanisms, such as liability insurance. An example of such a multilayered structure of compensation, combining insurance and government intervention, can be found in the nuclear liability legislation in India.

In 2010, India enacted the Civil Liability for Nuclear Damage Act.[170] According to this Act, a first layer of compensation has to be provided by the liable operator up to an amount of approximately $250 million (USD), and the nuclear operator is required to maintain insurance or financial securities to cover its liability.[171] Originally, the sole commercial operator in India managed the liability via self-insurance and a bank guarantee. However, the government, insurers, and reinsurers in India joined forces to create the India Nuclear Insurance Pool (INIP), which has a large amount of capacity providers to cover the nuclear operators' liability.[172]

In addition to the operators' liability (covered by the insurance pool), the government of India is bound to compensate a second layer of compensation up to approximately $420 million (USD).[173] Finally, there is a third layer as India also joined, in 2016, the Convention on Supplementary Compensation for Nuclear Damage, which provides an additional two tiers of compensation.[174]

A compensation fund is often a government-run mechanism established through legislation whereby the statute determines the financing and the

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[170] The Civil Liability for Nuclear Damage Act, 2010 (Ind.) (tries to make an instrument for repaying survivors of nuclear harm emerging from a nuclear incident).

[171] *Id.* at 6–7.

[172] *See generally* Ravi B. Grover, *The Civil Liability for Nuclear Damage Act of India: An Engineering Perspective Regarding Supplier's Liability*, 101 PROGRESS NUCLEAR ENERGY 168–75 (2017).

[173] *See* Aakanksha Joshi & Pooja Chatterjee, *Wading Through the Pool: Will the India Nuclear Insurance Pool be an Effective Risk Transfer and Management Mechanism?*, *in* XXII NUCLEAR INTER JURA CONGRESS, THE FUTURE OF NUCLEAR LAW: ADDRESSING SOCIETAL ENVIRONMENTAL AND BUSINESS EXPECTATIONS (2016); *see also* Ramandeep Singh Sidhu, *India's Civil Nuclear Liability Regime with Special Reference to Convention on Supplementary Compensation for Nuclear Damage*, *in* THE FUTURE OF NUCLEAR LAW: ADDRESSING SOCIETAL ENVIRONMENTAL AND BUSINESS EXPECTATIONS (2016). India is not a party to the international nuclear liability conventions but did sign the Convention on Supplementary Compensation as that is a separate, independent instrument. *Id.*

[174] *Id.*

conditions under which the fund will pay compensation. It is usually a permanent or ongoing arrangement that provides a right to compensation when the statutory conditions are met.[175]

Different from a permanent fund, where the conditions for victim compensation are determined *ex-ante* and in a structural way by regulation, occasionally governments provide for compensation payment on an *ad hoc* basis, for example, to compensate victims of a natural disaster.

In both mechanisms, the payment takes place through the government, yet there are important differences. A structural fund is a compensation mechanism that has a basis in regulation and signals *ex-ante* to the market under which conditions compensation will be provided. *Ad hoc* compensation is, to the contrary, not arranged in a structural manner. Only after a particular disaster will the government determine whether compensation will be provided without any obligation to do so. The amounts of compensation provided *ad hoc* can also differ. *Ad hoc* compensation is usually financed from the public purse (in other words, through the general taxpayers), whereas compensation funds can be financed by the operators who created the risk (e.g., through a levy on a risk-creating activity). Compensation funds are often used for damage arising from technological hazards (like marine oil pollution, where operators can contribute to finance the fund), while *ad hoc* compensation is often used in cases of natural hazards, where no liable party can be identified.[176]

2. Conditions

An essential element of any financial security is that the financing of the mechanism should provide efficient incentives to invest in preventive efforts. If the funds are financed through general taxes, there would be no incentive to prevent risky behavior, as there would be no connection between contributions into the fund and the activities that are creating the risk. One way to mitigate this is to give the fund a subsidiary character, meaning that other solutions (liability or insurance) should be used first, to the extent possible (i.e., that a liable injurer can be identified). In addition, the financing of the fund should ideally be organized in such a way that those who contributed to the risk also finance the compensation fund. If a tax is used to finance the fund, it should, to the extent

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[175] *Id.*

[176] Michael Faure, *Financial Compensation for Victims of Catastrophes: A Law and Economics Perspective*, 29 L. & POL'Y 339, 353–54 (2007).

possible, be a tax levy on activities related to the risk.[177] Finally, it would be important that the administrators of the fund are able to determine which victims satisfy the conditions for compensation according to the statutory conditions. Further, administering the fund should take place at low administrative costs. In order to lower these administrative costs, the compensation fund will often pay standardized lump sum amounts, thus avoiding a detailed analysis of the individual damage of the victim but providing amounts that may inevitably not fully correspond with the victim's damage.

Several important features emerge from the literature that has suggested a compensation fund for LMO-related damage. The first feature relates to the financing of the fund and requires that operators would contribute to the fund. As far as LMO-related risks are concerned, it is usually suggested that LMO operators would provide financial contributions.[178] A second feature concerns the relationship between the compensation fund and other financial security mechanisms like insurance. A compensation fund usually has a subsidiary character, providing an additional layer on top of the primary compensation provided by the liable operators (and their insurer) to the extent that insurance coverage would be available. The other possibility is that the compensation fund serves as an alternative to insurance solutions where insurance has not yet emerged, for example.[179]

3. Practice

According to insurers in Europe, there is no evidence of the existence of a comprehensive fund for LMO-related damage having been established anywhere in Europe.[180] This fund refers to a fund that would broadly cover all possible types of LMO-related damage (both first-party and third-party damage to biodiversity as well as traditional damage). There have been, however, LMO funds that supplement the traditional liability system and usually indemnify only traditional farmers.[181] A special fund solution was developed in the Netherlands where all stakeholders agreed through a covenant to provide compensation to all who suffer damage resulting from the adventitious presence of LMOs in non-GM crops. All stakeholders and, initially, the State have contributed to this

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177 Faure & Hartlief - *Compensation Funds*, *supra* note 166, at 322–24.

178 Jungcurt & Schabus, *supra* note 33, at 205.

179 Ebert & Lahnstein, *supra* note 42, at 579.

180 *Id*. The conclusion that no such fund has been established is only drawn by the authors for the European context.

181 *Id.*

fund.[182] An interesting aspect of this fund is that it was introduced as part of a set of measures to prevent admixture and gene flow by introducing mandatory distances between GM and non-GM crops.[183] Farmers that followed these strict distancing rules would no longer be liable for damage resulting from admixture. Since the GM farmers who followed the best practice were exempted from liability, a fund was established to guarantee compensation to non-GM farmers whose crops were damaged through gene flow.[184] However, the model was still being developed further and also included State intervention.[185] While this example may not address damage as defined in the NKLSP, it nonetheless shows that financial security can, under particular conditions, support GM production and work as a confidence builder through guaranteed compensation to non-GM farmers.[186]

The Walloon Region in Belgium had extended the scope of an already existing fund to also cover damage from the adventitious presence of GM-plants in conventional or organic crops.[187] Denmark also introduced legislation on a compensation fund for damage arising from LMO admixture.[188] The fund was financed by GM-crop growers who paid a particular amount per hectare of GM cultivation into a fund administered by the Danish Plant Directorate (a division of the Ministry of Agriculture).[189] A compensation fund was also created in Portugal, financed through a green tax on seeds.[190]

Compensation funds also exist for environmental damage. For the compensation of nuclear damage, two separate international compensation regimes were established in the 1960s, and both were substantially revised after the Chernobyl accident of 1986.[191] The funds have been established under the nuclear conventions[192] and are built on a multi-layered compensation scheme

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182 CBD Secretariat 2007, *supra* note 9, at 3.

183 *Id*.

184 *Id*.

185 Koch, *supra* note 14, at 633–34.

186 *See also* Ramesh Bikram Karky & Mark Perry, *Disharmonization in the Regulation of Transgenic Plants in Europe*, 38(6) BIOTECHNOLOGY L. REP. 350–75 (2019).

187 Koch, *supra* note 14, at 629.

188 *Id*.

189 *Id*. at 630.

190 *Id*. at 631.

191 *Id*.

192 Convention on Third Party Liability in the Field of Nuclear Energy, July 29, 1960, 1988 U.N.T.S. 329; SUPPLEMENTARY CONVENTION TO THE PARIS CONVENTION OF JANUARY 31, 1963 (July 29, 1960), https://www.oecd-nea.org/jcms/pl_31528/brussels-supplementary-convention-full-text. A second regime was developed under the aegis of the International Atomic Energy Agency (IAEA).

where liability is channeled to the operator of the nuclear power plant, and the operator is liable up to the amount of the financial cap (€57 million). Up to that amount, the operator needs to show financial security. In addition, two further layers of compensation were added via public funds. A second tier of compensation is paid out of public funds made available by the contracting party in the territory the nuclear installation of the liable operator is situated (with a cap of €193.7 million). A third tier of compensation is paid out of public funds made available by the contracting parties according to a formula for contributions which is based on the Good Manufacturing Practices and the thermal capacity of the reactors on their territory (with a cap of €142.4 million).[193] This third tier applies to damage that goes beyond the amount provided in the second tier.[194] Finally, on September 12, 1997, the Convention on Supplementary Compensation for Nuclear Damage (CSC) was adopted, a new and independent legal instrument providing additional compensation.[195]

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[193] *Id*.

[194] These amounts have been increased since the adapted conventions were enacted after the Chernobyl accident entered into force on January 1, 2022. The compensation regime for nuclear accidents has also been studied during the negotiations preceding the NKLSP. *See also* UNEP CBD SECRETARIAT, DISTR. CONVENTION ON GENERAL BIOLOGICAL DIVERSITY UNEP/CBD/ICCP/2/3 LIABILITY AND REDRESS FOR DAMAGE RESULTING FROM THE TRANSBOUNDARY MOVEMENTS OF LIVING MODIFIED ORGANISMS REVIEW OF EXISTING RELEVANT INSTRUMENTS AND IDENTIFICATION OF ELEMENTS 4–7 (2001) [hereinafter CBD Secretariat 2001], https://www.cbd.int/doc/meetings/bs/iccp-02/official/iccp-02-03-en.pdf; CBD Secretariat 2006, *supra* note 9, at 2–3.

[195] *See also* JING LIU, COMPENSATING ECOLOGICAL DAMAGE: COMPARATIVE AND ECONOMIC OBSERVATIONS 214 (2013); PHILIPPE SANDS & JACQUELINE PEEL, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW 740 (2012).

The available amounts of compensation under the international nuclear liability conventions from different sources can be summarized as follows:

Available amounts of compensation under the International Nuclear Liability Conventions[196]			
Amount in million (€) euros			
What convention?	Who pays?	First generation	Second generation
Paris Convention	Nuclear operator	57	700
Brussels Supplementary Convention	Installation State (or Nuclear operator)	193.7	500
	Collective State Fund	142.4	300
Total NEA-regime		341.8	1,500
Vienna Convention	Nuclear operator	4.2	170.9
	Collective State Fund	-	170.9
Total Vienna Convention		4.2	341.8
Convention on Supplementary Compensation	Operator/installation State		341.8
	Collective State Fund		341.8
Total CSC			683.7

The compensation regime for nuclear accidents has also been studied during the negotiations preceding the SP.[197]

A compensation fund has also been created to deal with marine oil pollution. Marine oil pollution is compensated primarily by the tanker owner, who is also subject to mandatory financial guarantees.[198] The basis for that liability is identified in the International Convention on Civil Liability for Oil Pollution Damage (CLC).[199] Under the CLC, there is limited liability for the tanker

[196] Michael Faure & Tom Vanden Borre, *Compensating Nuclear Damage: A Comparative Economic Analysis of the U.S. and International Liability Schemes*, 33 WM. & MARY ENV'T. L. & POL'Y REV. 219, 239 (2008).

[197] *See also* CBD Secretariat 2001, *supra* note 194, at 4–7; CBD Secretariat 2006, *supra* note 9, at 2–3.

[198] These guarantees are usually provided via insurance offered by the P&I Clubs, a risk-sharing agreement. *See* discussion *supra* Section III.D.

[199] INTERNATIONAL OIL POLLUTION COMPENSATION FUNDS, LIABILITY AND COMPENSATION FOR OIL POLLUTION DAMAGE (1992), https://iopcfunds.org/wp-content/uploads/2018/06/Text-of-Conventions_e.pdf.

owner.[200] Precisely because it was expected that the damage could be higher than the financial cap, a second convention, the 1971 Fund Convention, created the International Oil Pollution Compensation Fund. That fund is financed by levies on the oil transported, which is paid by the oil receivers.[201] The regime was meant to create a balance by having the maritime industry (tanker owners) pay under the CLC and the oil industry under the 1971 Fund Convention.[202] Those conventions have been amended many times, but the basic principles remain the same.[203] Finally, in 2003, a supplementary fund was created to provide a layer of compensation beyond the capped liability of the tanker owners and the compensation provided through the 1971 Fund Convention. This supplementary fund is financed via levies paid by the oil receivers. The international regime for maritime oil pollution, therefore, consists, on the one hand, of tanker owners' limited liability and, on the other hand, of compensation provided through a fund financed by oil receivers. This structure differs importantly from the nuclear liability regime because it is not the state that finances the second layer but rather oil receivers ensuring a financial contribution from a wider range of operators.[204]

4. Analysis

Compensation funds are usually created by governments. Depending upon the nature of the risk, it could be national governments; for some risks (mostly of a transboundary nature) an intergovernmental entity can be created.

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[200] *See generally* Michael Faure & Wang Hui, *The International Regimes for the Compensation of Oil-Pollution Damage: Are They Effective,* 12 REV. EUR. CMTY. & INT'L ENV'T. L. 242 (2003).

[201] The oil receivers can be the commercial entities importing the oil or states (if it is the state that receives the oil). *See* Michael Faure & Hui Wang, *Economic Analysis of Compensation for Oil Pollution Damage*, 37 J. MAR. L. & COM. 179, 213 (2006) [hereinafter Faure & Wang - *Economic Analysis*].

[202] *See generally* Hui Wang, Civil Liability for Marine Oil Pollution Damage: A Comparative and Economic Study of the International, US and Chinese Compensation Regime (Aug. 2010) (Thesis, Erasmus University Rotterdam).

[203] The amendments took place in order to adapt the amounts of compensation to new evidence concerning the damage resulting from oil pollution incidents. *See* Jing Liu, Michael Faure & Hui Wang, *Compensating for Natural Resource Damage Caused by Vessel-Induced Marine Oil Pollution: Comparing the International, U.S. and Chinese Regimes*, 29 J. ENV'T L. & LITIG. 123, 138 (2014).

[204] For a comparative analysis of both regimes, see Michael Faure, *In the Aftermath of the Disaster: Liability and Compensation Mechanisms as Tools to Reduce Disaster Risks*, 52 STAN. J. INT'L L. 95, 153 (2016). Also, the international regime for compensating oil pollution damage has been discussed at large in the documents preceding the NKLSP. *See* CBD Secretariat 2001, *supra* note 194, at 7–9; CBD Secretariat 2006, *supra* note 9, at 5–6; UNEP CBD Secretariat, RECENT DEVELOPMENTS IN INTERNATIONAL LAW UNEP/CBD/BS/GF-L&R/1/INF/1 RECENT DEVELOPMENTS IN INTERNATIONAL LAW RELATING TO LIABILITY AND REDRESS, INCLUDING THE STATUS OF INTERNATIONAL ENVIRONMENT-RELATED THIRD PARTY LIABILITY INSTRUMENTS 10–12 (2009), https://www.cbd.int/doc/meetings/bs/bsgflr-01/information/bsgflr-01-inf-01-en.pdf.

Theoretically, compensation funds can also be arranged via non-governmental (private) entities. That is, however, more exceptional as the compensation fund usually requires state intervention to regulate the financing (either via contributions by risk-creators or via general taxation). Theoretically, private parties could agree on creating a fund among themselves privately, but then it would rather take the form of either a risk pooling scheme or some type of hybrid arrangement.

Compensation funds have, as a main disadvantage, that the financing is usually not risk-related, thus providing insufficient incentives for prevention.[205] The difficulty is that it is often impossible (or very costly) to determine each stakeholder's contribution to the risk and to establish the respective contribution they are required to pay.[206] The case of compensation for nuclear risk has been subject to criticism for this reason: liable operators are only exposed to relatively low amounts of liability, shifting the largest part of the compensation to states' budgets, thus allowing insufficient preventive effects.[207] The international regime to compensate marine oil pollution is different in the sense that the layers of compensation are funded by the operators in the oil industry and transport (i.e., tanker owners, their P&I Club, and oil receivers).[208] Still, even with the (IOPC Fund[209]), contributions are not related to risk but only to the amount of oil received, making risk differentiation imperfect.[210] This underscores the difficulty in creating a regime of risk differentiation (providing incentives for prevention) with a compensation fund.

For example, while compensation funds are usually created by governments, there can also be instances where a fund is created by a private entity. This may occur when an operator is liable for catastrophic damage. In that case, a fund can be created to settle the massive claims of the victims. The fund is, in that case, not created in a structural manner but rather *ad hoc* following a disaster and therefore related to one specific event (and usually of limited duration).

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[205] Koch, *supra* note 14, at 621.

[206] *Id*. at 620.

[207] TOBIAS HELDT, A EUROPEAN LEGAL FRAMEWORK FOR NUCLEAR LIABILITY: RETHINKING CURRENT APPROACHES (2015); Michael Faure & Tom Vanden Borre, *Compensating Nuclear Damage: A Comparative Economic Analysis of the US and International Liability Schemes*, 33 WM. & MARY ENV'T L. & POL'Y REV. 219, 221–22 (2008).

[208] For a comparison of the two regimes, see Liu, Faure & Wang, *supra* note 203, at 150–55.

[209] The IOPC Funds provide financial compensation for oil pollution damage that occurs in Member States, resulting from spills of persistent oil from tankers.

[210] Faure & Wang - *Economic Analysis*, *supra* note 201, at 203.

An example of such a privately financed *ad hoc* compensation fund is the Gulf Coast Claim Facility (GCCF) initiated by BP in June 2010 after the Deepwater Horizon incident. The GCCF worked according to an alternative dispute resolution model offering a low threshold compensation to victims.[211] In a period of one and a half years, the GCCF was able to process over one million claims, paying more than $6.2 billion (USD) to victims. Compared to the court system, such an alternative model can provide rapid compensation according to a simplified procedure to large numbers of victims.[212]

5. Role for Government

The compensation fund is usually created and administered by the government. This can either be at the domestic level (a national government) or at the intergovernmental level (with a legal basis in a treaty). Government intervention is important to create the legal structure for the compensation fund and to determine the financial contribution to the fund by operators. Governments usually collect the contributions, but it is not necessarily the government that finances the compensation fund (at least not entirely) with taxpayers' money.

6. Summary

In summary, a compensation fund can ensure payment in cases where liability and insurance can, for a variety of reasons, not be applied. It could be the case that there is no liable party (such as with natural disasters);[213] it is possible that the individual polluter cannot be identified or that they are insolvent. The compensation fund could also intervene in cases where the damage exceeds the financial cap of the liable operator or the amounts covered by insurance.[214] A compensation fund may also have procedural advantages by adjusting the administration of the fund to specific needs, thus reducing the barriers for claimants.[215] A compensation fund can be structured to potentially provide additional compensation. The way in which a fund is structured is usually that it has a subsidiary character, i.e., providing compensation on top of

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211 *See also* KENNETH R. FEINBERG, WHO GETS WHAT: FAIR COMPENSATION AFTER TRAGEDY AND FINANCIAL UPHEAVAL (2012); Michael Faure & Franziska Weber, *Potential and Limits of Out-of-Court Rapid Claims Settlement – A Law and Economics Analysis*, 28 J. ENV'T L. 125, 138 (2016).

212 *Id.*

213 Although in that case often *ad hoc* compensation is arranged.

214 CBD Secretariat 2006, *supra* note 9, at 8.

215 Koch, *supra* note 14, at 620.

other layers of payments made by a liable operator and the financial security provider. Finally, provided that the compensation fund is able to collect sufficient contributions, it can have the capacity to compensate for the damage. If there are unknown or hard-to-predict risks, actual claims on the fund may exceed expectations.[216] Meanwhile, its main disadvantage is that the financing is usually not risk-related, thus providing insufficient incentives for prevention.[217]

F. Other Financial Security Mechanisms

The four financial security mechanisms discussed above are considered the most relevant in the context of Article 10 of the NKLSP. As also set out in that section, a number of other financial security mechanisms exist that are, for one reason or another, considered less relevant in the context of the NKLSP. This section will briefly review these other financial security mechanisms and describe the reasons why they are considered less relevant and, therefore, not further considered in this article.

1. Bonds

Bonding is an instrument allowing financial risks to be covered on the capital market.[218] The principle is that bonds are issued whereby the interest rate on the bond reflects the potential accident rate. Investors can buy a bond in favor of the operator of their choice. If no accident happens during the period of the bond (say one year), the amount of the guarantee provided by the bond would be paid with interest.[219] If the risk materializes, the bond posted would be used to cover the damage.[220] Bonding has been discussed in connection to carbon capture and storage, among other areas.[221] Bonds usually work for sudden events like catastrophes but are considered less useful to cover long-term liabilities. In practice, bonds are, therefore, hardly ever used to cover environmental liability. Considering the need to deal with potential long-term damage, bonds would not

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[216] *Id.* at 620–21 (arguing that this may be a risk in case of LMO-related damage).

[217] *Id.* at 621.

[218] *See generally* James Boyd, *Financial Responsibility for Environmental Obligations: Are Bonding and Assurance Rules Fulfilling Their Promise?*, 20 INTRO. L. & ECON. ENV'T POL.: ISSUES INST'L DESIGN 417–85 (2002).

[219] *Id.*

[220] *See also* Jean-Robert Tyran & Peter Zweifel, *Environmental Risk Internalization Through Capital Markets (ERICAM): The Case of Nuclear Power*, 13 INT'L REV. L. & ECON. 431, 431–34 (1993).

[221] FAURE & PARTAIN, *supra* note 10, at 179–82.

be a suitable instrument to cover the type of biodiversity damage envisaged by the NKLSP.

2. Bank Guarantees and Deposits

A guarantee comes down to a private party (e.g., a bank) providing a financial guarantee that it will meet the obligations of an operator. The idea is that the financial institution guarantees it will cover the liabilities of the operator in case a particular risk materializes. On paper, this seems attractive, especially when the operator would have little assets and could receive a guarantee from a solvent financial institution. However, the reason a bank guarantees are rarely found in practice for environmental liabilities is that the cost of those guarantees can be prohibitively high.[222] As bank guarantees are considered relatively expensive (especially when compared to insurance), they do not seem to be an attractive financial security instrument either.

3. Government Compensation

An alternative also mentioned in the literature with respect to LMO-related damage is that the government could simply pay the compensation if the risk materializes.[223] In theory, the government could, in a specific case, always decide to provide *ad hoc* compensation. Take an *ad hoc* contractual solution as an example: a feed producer in Germany (Märka) guaranteed, with the support of seed producers, to buy the entire maize production of farmers who were growing maize conventionally within one hundred meters of GM maize fields, irrespective of potential admixture.[224] The GM farmers participating in the project had to contractually commit themselves to adhere to the farming standards established by seed producers.[225] The project was launched in 2005 but discontinued in 2007.[226] In this contractual example, the producer took over the risk from GM farmers, but it is not a risk-sharing agreement. While this

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[222] *Id*. at 178. Compared to insurance, one can hold that if insurers specialize in LMO-related risks, they may have more information for an appropriate risk-differentiation and premium setting as a result the costs of insurance could be lower than the costs of a bank guarantee.

[223] John Paull, *Contamination of Farms by Genetically Modified Organisms (GMOs): Options for Compensation*, 6 J. ORGANICS 31, 36, 40 (2019).

[224] Ebert & Lahnstein, *supra* note 42, at 580; Koch, *supra* note 14, at 634. The literature does not mention the reason why the project was discontinued.

[225] *Id*.

[226] *Id*.

example may not address damage as defined in the NKLSP, it nevertheless shows how compensation for damage may be provided.

There is not necessarily a requirement for a specific regulatory framework to be in place for the government to decide *ad hoc* to compensate. This major disadvantage is that when the government pays, no adequate incentives for the prevention of risks are provided to operators.[227] One scholar, therefore, considered *ad hoc* compensation (for natural disasters generally) a "catastrophic response to catastrophic risk."[228]

G. Conclusion

This section examined four main financial security mechanisms—(re)insurance, self-insurance, risk pooling, and funds.

There are often no walls between the various mechanisms. In practice, a variety of instruments may emerge, but it is not always possible to qualify any one specific instrument as, for example, risk-pooling or a fund. There are, in other words, grey areas between different mechanisms, as a result of which they could rather be qualified as hybrids. Indeed, many of the examples described combine features of different financial security mechanisms, including the fund created in the Netherlands to cover damage from the adventitious presence of LMOs and the arrangements established under the nuclear conventions.[229]

The analysis showed that each of the mechanisms discussed have particular advantages, but also specific limits and disadvantages. It is precisely for that reason that a combination of different mechanisms can often be observed in practice, especially when compensating catastrophic environmental damage. These so-called smart mixes of mechanisms[230] could consist of mechanisms created at different levels of governance (national or international initiatives) involving both public and private initiatives. For example, private governance via risk-pooling or self-insurance, domestic legislation mandates the purchase of liability insurance and an intergovernmental instrument creating a compensation fund.

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[227] Dari-Mattiacci & Faure, *supra* note 60.

[228] Richard A. Epstein, *Catastrophic Responses to Catastrophic Risks*, 12 J. RISK UNCERTAINTY 287, 297 (1996).

[229] *See supra* Section III.E.3.

[230] *See also* Judith van Erp et al., INTRODUCTION TO SMART MIXES FOR TRANSBOUNDARY ENVIRONMENTAL HARM 3, 7 (Judith van Erp et al. eds., 2019).

An example of a multi-layered compensation scheme is a system developed in the Netherlands for terrorism-related risks, an area with high uncertainty. After the U.S. 9/11 Attacks, insurance companies sought to exempt damage related to terrorism from their coverage.[231] Following that initial reaction, negotiations took place between insurers, reinsurers, and governments.[232] After, the pool constructions emerged in many jurisdictions; these constructions usually consist of a multi-layered approach, whereby a first layer is provided by insurers, a second by the reinsurance market and a third by the government.[233] The Dutch terrorism reinsurance pool provides an interesting example. The pool was originally constructed with €1 billion in total, which included €400 million by insurers, €300 million by reinsurers, and €300 million by the Dutch government.[234]

The Dutch government intervened in this terrorism-related market by facilitating the provision of insurance, but it demands a premium for its reinsurance capacity.[235] The fact that the government demands a premium for the third layer of reinsurance it provides indicates that the State intervention is not a subsidy or state aid. The premium charged by the government was, moreover, so high that it provided an incentive to the market players (insurers and reinsurers) to develop their own additional capacity. As a result, the governmental coverage could be reduced to €50 million since insurers and reinsurers increased their contribution.[236]

A mix of different mechanisms could also be employed to cover damage to biodiversity caused by LMOs. Some authors have proposed a model of a multilayered system where operators would intervene first via internal reserves or liability insurance, and a compensation fund financed by all operators jointly would provide a second layer of compensation.[237] In this proposal, the compensation scheme would be a supplementary scheme (on top of the capped operators' liability covered by financial security) and could consist either of an intergovernmental scheme or risk-pooling by industry.[238]

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231 VÉRONIQUE BRUGGEMAN, COMPENSATING CATASTROPHE VICTIMS: A COMPARATIVE LAW AND ECONOMICS APPROACH 456 (2010).

232 *Id.*

233 *Id.*

234 *Id.*

235 *Id.*

236 *Id.*

237 Jungcurt & Schabus, *supra* note 33, at 205.

238 *Id.*

Hybrid approaches to financial security can help in situations where obtaining financial security is mandatory. When mandatory financial security is required, it is often considered important to formulate the obligation to obtain financial security in a broad manner in order to provide incentives to the market to develop a wide array of different financial security mechanisms. If policymakers were to limit financial security to mandatory insurance, it would become totally dependent on insurance to fulfill that duty. It would make insurers the *de facto* licensors of the activity. A flexible approach would instead allow the market to develop a wide variety of financial security mechanisms as long as they can guarantee compensation when damage occurs.

An example of a flexible approach is carbon capture and storage. The European Union has developed a Guidance Document describing the possible financial security mechanisms that could be used to cover risks related to carbon capture and storage.[239] This provides information to the licensing authorities on the type of financial security that can be accepted when offered by operators.[240] The approach has the advantage of allowing sufficient flexibility and avoiding unnecessary costs (e.g., forcing major operators to transfer risks to an insurance company). The model requires financial security but leaves flexibility for local regulators to determine the amount and form of financial security, taking into account the specific risks posed by the site and the specific features of the operator. The model also sets standards concerning the type of financial security that would be acceptable. A similar model for carbon capture and storage is used in the U.S. Environmental Protection Agency Guidance Document on Underground Injection Control Financial Responsibility Guidance.[241] The document lists qualifying instruments, but the list is neither exhaustive nor absolute, so operators can also propose other financial security mechanisms to be approved by the authority.[242]

Several jurisdictions have models of mandatory financial security, including for environmental risks, in particular for oil pollution and nuclear risks. Those domestic regulations are mostly based on international conventions.[243] Mandatory financial security also exists for many other environmental risks and, more particularly, for the oil pollution and nuclear risks as set out in Sections

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239 *Implementation of Directive 2009/31/EC*, *supra* note 130.
240 *Id.*
241 FAURE & PARTAIN, *supra* note 10, at 189.
242 *Id.*
243 *See also supra* Section III.E.3.

III.C.3 and III.E.1 above. These security mandates are prescribed in a number of other international treaties, including the 1952 Rome Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface;[244] the 1999 Montreal Convention for the Unification of Certain Rules for International Carriage by Air;[245] the 1996 Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea;[246] and the 2003 Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters.[247] Obtaining financial security has been made mandatory in all of these international conventions.

III. ASSESSMENT OF IMPACTS

A. Introduction

This section will, as prescribed by Article 10(3) of the NKLSP, provide a description of the economic, social, and environmental impacts of the various financial security mechanisms that have been discussed in the previous sections. Attention will be paid particularly to the impacts of the different mechanisms on

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[244] Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface Oct. 7, 1952, 310 U.N.T.S. 181. It entered into force on February 4, 1958, and as of 2018 has been ratified by 51 states. *Id.*

[245] Convention for the Unification of Certain Rules for International Carriage by Air, May 28, 1999, 2242 U.N.T.S. 309. The Convention, better known as the Montreal Convention, is a multilateral treaty adopted by a diplomatic meeting of ICAO member states in 1999. It amended important provisions of the Warsaw Convention's regime concerning compensation for the victims of air disasters. The Convention attempts to re-establish the uniformity and predictability of rules relating to the international carriage of passengers, baggage, and cargo. Whilst maintaining the core provisions that have served the international air transport community for several decades (i.e., the Warsaw regime), the new treaty achieves modernization in a number of key areas. It protects passengers by introducing a two-tier liability system that eliminates the previous requirement of proving willful neglect by the air carrier to obtain more than $75,000 (USD) in damages, which should eliminate or reduce protracted litigation. *Id.*

[246] International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, May 3, 1996. This Convention, also known as HNS Convention, is an international convention created in 1996 to compensate for damages caused by spillage of hazardous and noxious substances during maritime transportation. The convention has not entered into force due to signatory states not meeting the ratification requirements.

[247] Protocol on Civil Liability for Damage and Compensation for Damage Caused by Transboundary Effects of Industrial Accidents on Transboundary Waters was adopted in Kiev, Ukraine on May 21, 2003. The Protocol is a joint instrument to the Convention on the Transboundary Effects of Industrial Accidents and to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The Protocol was signed by twenty-four European states but as of 2013, the Protocol has been ratified by only Hungary and is not in force. *See* Jing Liu, Michael Faure & Niels Philipsen, *Liability for Terrorism-Related Risks Under International Law*, *in* CIVIL LIABILITY IN EUROPE FOR TERRORISM-RELATED RISK 11, 52 (Lucas Bergkamp et al. eds., 2015).

the stakeholders throughout the LMO supply chain (developers, traders, and users), but also on society at large. When looking at the economic impacts of financial security mechanisms, this section will focus on the economic and financial impacts on stakeholders in the supply chain of the mechanism itself. Beyond the economic considerations of the different types of financial security mechanisms, it might also be mentioned that international trade law may be relevant in this regard. How particular financial security measures should be considered under international trade law depends on the specific measures taken by a country.

B. Approach

Given the limited availability at present of financial security mechanisms for damage related to LMOs, this article will assess the impacts of the four main financial security mechanisms described in Section III above, trying to draw parallels to financial security in the context of the Supplementary Protocol.

A useful theoretical basis for analyzing those impacts can be found in the work of Guido Calabresi on the costs of accidents.[248] Calabresi argues that the goal of liability law should be to minimize the total costs of accidents.[249] Calabresi thereby distinguishes the costs of prevention (investment by an operator to prevent the risk from occurring), the damage costs (the losses that would occur in case of an accident) and the costs of loss-spreading (those with the best capacity to carry the loss, for example, because they are insured, should cover the loss).[250] Finally, Calabresi also identifies the administrative or transaction costs of administering the liability regime (e.g., costs of lawyers, court fees etc.).[251] Calabresi distinguishes between these costs as follows:

- Primary accident costs are the costs of prevention and the expected losses;
- Secondary accident costs are the costs of loss-spreading; and
- Tertiary accident costs are the costs of administrating the accident compensation system, in other words, administrative or transaction costs.[252]

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248 *See generally* GUIDO CALABRESI, THE COSTS OF ACCIDENTS A LEGAL AND ECONOMIC ANALYSIS (1970).
249 *Id.*
250 *Id.*
251 *Id.*
252 *Id.*

This distinction is helpful in providing an approach to analyze the different types of impacts of financial security mechanisms for LMO-related damage.

When looking at the economic impacts, the financial security mechanism can create particular tertiary costs related to their application, such as the administrative costs of running the financial security mechanism.

The social impacts, such as effective loss-spreading, relate more to Calabresi's secondary costs. The secondary costs relate to the risk attitudes of the different stakeholders. Based on the risk attitude, the question can be asked which party would (e.g., given the available financial assets) be better able to carry the risk and to spread the loss. This is related to the fact that if damage falls on the shoulders of a group of individuals who socially would be less able to sustain these costs, financial security mechanisms could help allocate these costs where they can be handled most effectively.

The environmental impact is related to the reduction of primary accident costs. In that respect, the question can be asked to what extent the specific financial security mechanism provides adequate incentives for optimal prevention of LMO-related damage. The environmental impact can also be considered from the perspective of whether the particular financial security mechanism enables an operator to fulfill its duties concerning liability and redress under the NKLSP.

In addition, specific attention will be paid to the impacts of the various mechanisms on developing countries, as required by Article 10(3)(b) of the NKLSP.

C. Insurance and Reinsurance

1. Economic

The most obvious economic cost of insurance is the cost of the premium to be paid by the insured. Indeed, according to the Coase theorem,[253] when parties are bound via the price mechanism, an increase in costs (such as an insurance premium) will (to the extent that the market allows) be passed on by the operator

[253] Ronald Coase, *The Problem of Social Cost*, 56 J. L. ECON. 837, 846 (1960).

in the final price.[254] Generally speaking, insurance is considered an expensive financial security mechanism, primarily because it requires payment of a premium *ex-ante* and involves administrative costs. For this reason, as explained above, large operators often prefer the option to use other less costly alternatives to seek financial security (such as self-insurance or risk-sharing). The costliness of insurance can also present challenges for small- and medium-sized operators who may not be able to afford the expense.

The payment of an insurance premium could, in principle, lead to an increase in the prices of products deriving from LMOs[255] but whether this passing on of the cost through the price mechanism is of substantial importance (especially compared to products that are not derived from LMOs) is at this moment hard to judge. As explained above, LMOs are still largely excluded from insurance policies, and even less cover LMO-related damage to biodiversity, meaning it is difficult to know how heavy a burden the insurance premium would be.

Theoretically, all kinds of scenarios are possible. If insurance costs are substantial, non-GM products might become economically more attractive by comparison. In addition, substantial insurance costs could drive operators to countries where financial security requirements are less stringent. At the extreme, very high insurance premiums could drive operators out of the market. Some of these economic effects would have obvious social repercussions as well, discussed in the next subsection. According to the literature, concerns regarding the higher prices that could result from insurance premiums were an important reason not to impose mandatory financial security under the NKLSP.[256]

Another aspect of the economic costs relates to the costs of the operation of insurance. Indeed, insurance premiums are always higher than the objective value of the risk. They at least include the administrative costs for the operation of insurance. These administrative costs will be higher for insurance than when internal reserves are used in the case of self-insurance but could be lower than with a compensation fund.[257]

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[254] Koch addresses that "it is actually the ultimate consumer who pays the insurance premiums: the GM farmer will inevitably try to pass on these costs to her customers, or at least include them in her calculation." *See* Koch *supra* note 14, at 617.

[255] *See also* Telesetsky, *supra* note 33, at 105.

[256] *Id*. ("[T]here was a fear that financial security might result in higher prices for genetically modified crops and animals.").

[257] Faure & Hartlief - *Compensation Funds*, *supra* note 166, at 323.

Insurance may also have some economic benefits. Access to insurance would give operators the possibility to spread the costs of the risk of damage over a large group of insured through the insurer. Furthermore, insurance premiums are usually a stable and thus predictable operating cost that may be integrated into long-term production costs.

2. Social

The advantage of insurance, especially first-party insurance, is that it can provide cover corresponding exactly to the risk attitude (and therefore demand of the financial security) of the insured. From a social perspective, however, a disadvantage of a first-party system is it implies that a potential victim pays the premium for its own potential damage. Where a third party is liable, it might be problematic to require a victim to pay for the damages through a first-party insurance premium. Some have, therefore, argued that it is inherently unfair for non-GM farmers to bear the costs of premiums when they are not causing the potential damage.[258] Others have expressed opposition to an insurance compensation mechanism that would impose a financial burden of paying the premium on organic and non-GM farmers rather than on producers of LMOs.[259] In this view, the social effects of insurance would be fairer if those creating the risks were the ones required to take insurance. This could be achieved through third-party insurance where, for example, certain operators in the supply chain would take out insurance for damage to biodiversity caused by LMOs. The insurance costs would be passed on to the users of the LMOs, and not cause negative social effects on users outside the LMO-supply chain.

The payment of an insurance premium may be difficult for small and medium-sized operators. It is for that reason that if mandatory financial security were to be introduced, a flexible approach should be followed, not limiting financial security to insurance. Especially when the insurance market is not yet well developed, and sufficient competition is lacking; there is a danger that insurance premiums might be relatively high as insurers are likely to add a risk

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[258] Paull, *supra* note 223, at 30; STANDING COMMITTEE ON ENVIRONMENT AND PUBLIC AFFAIRS, WESTERN AUSTRALIA LEGISLATIVE COUNCIL, MECHANISMS FOR COMPENSATION FOR ECONOMIC LOSS TO FARMERS IN WESTERN AUSTRALIA CAUSED BY CONTAMINATION BY GENETICALLY MODIFIED MATERIAL 31 (2019), https://parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/48C54E375ABB4DCB482583A1000D364D/$file/full%20GM%20report.pdf.

[259] Dan Flynn, *AC21 Wants USDA to Investigate Crop Insurance for Genetic Harm to Organic Crops*, FOOD SAFETY NEWS (Nov. 12, 2012), https://www.foodsafetynews.com/2012/11/ac21-wants-usda-to-investigate-crop-insurance-for-genetic-harm-to-organic-crops/.

premium to deal with insurer ambiguity. This would be problematic for small- and medium-sized operators and could put them at a disadvantage to larger operators, especially if insurance were to be mandatory.[260]

Third-party insurance could play a role for certain operators in developing countries (such as importers or GM farmers). The very limited availability or even lack of insurance products for LMO-related damage also applies to the developing country context. In addition, issues related to monitoring, governance, and enforcement of insurance mechanisms may be particularly challenging.

3. Environment

The incentives for prevention under insurance are strong as a result of the control of moral hazard by the insurance company. The insurer will, through risk differentiation, adapt policy and premium conditions in order to give incentives for prevention.

Insurance guarantees that the proceeds of insurance can be used towards the cost of response measures if damage were to occur. For the environmental benefits to be optimal, coverage must be sufficient to pay for the costs of restoration.

Restoration would also be facilitated if those who incur costs for taking response measures have a direct action on the insurer to claim the insurance proceeds rather than an action against the liable operator (assuming it is not the operator taking the response measures). Direct action on the insurer allows the claimant to directly receive payment, even if the insured operator did not comply with particular conditions in the insurance policy (the so-called fine print). In such a case, the insurer, after having paid the compensation to the claimant, can seek recourse from the insured if coverage conditions appear not to have been met.

D. Self-Insurance

1. Economic

As detailed above, self-insurance consists of (usually larger) operators making their internal reserves available as financial security. Administrative

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[260] Nijar, *supra* note 4, at 284.

costs for self-insurance are low and arise primarily at the moment when damage occurs and compensation needs to be paid and also, to some extent, when setting up the arrangements for the self-insurance. In addition, self-insurance, as opposed to regular insurance, generally does not require the involvement of an external entity, thus contributing to cost-savings. However, the system is effective only if sufficient financial reserves are available and used for compensation when needed.[261] This requires some level of external control and monitoring, leading to some expenses.

In order to make self-insurance work, operators would need to have reserves or assets that can be used in case of liability for damage to biodiversity. To avoid disinvestments, self-insurance would usually only require operators to show that they have sufficient assets on their balance sheets that can be liquidated in case of liability for damage to biodiversity. This means that assets are not necessarily immobilized as long as no damage occurs. Since self-insurance requires large assets, it is an instrument mostly used for larger players in the supply chain. The economic impact would generally only be felt if damage were to arise, and costs would be passed on in the value chain only when damage occurs.

The inherent risk of self-insurance is that a company providing self-insurance is not able to meet the claims, for example, when the company is insolvent (either as a result of the claims for damages or for other reasons). In such a situation, the economic impact of self-insurance is that others will need to bear the costs of the response measures or the ongoing economic costs of the damage if no other entity assumes the responsibility of taking the response measures.

2. Social

In principle, under self-insurance, an operator can choose the appropriate level of reserves, taking into account its own risk exposure and risk attitude. It is, therefore, a system that can align the demand for security to the risk attitude. From a distributional perspective, however, self-insurance can be problematic, as generally, only those operators with large assets can afford this type of security. It will not be available for small- and medium-sized enterprises and most likely not for (small) farmers either. They will, therefore, have to call on other types of financial security (if they are available at all) for which they may have to pay. That could potentially create inequality between actors of different

[261] Similar to the way this happens within OPOL.

sizes. It may also have differing impacts in developed versus developing countries. Even for larger entities in developing countries, self-insurance may not be available if systems for assessing or reviewing the solvency of operators and monitoring self-insurance guarantees are not available.

Furthermore, the risk of insolvency in the case of large claims may lead to situations in which insufficient funds are available to cover the costs of the damage, especially if the reserves for financial security have not been protected from the claims of other creditors. As a result, society at large or other actors may end up bearing the costs of the damage.

3. Environment

In principle, self-insurance creates excellent incentives for prevention, as the operator is not able to shift the risk to a third party, and therefore no moral hazard risk emerges. That, however, supposes that the reserves are sufficient to cover the potential loss and that no insolvency problem arises.

If the internal reserves are effectively used to restore biodiversity, the negative ecological effects of damage to biodiversity will be mitigated. However, self-insurance only provides a guarantee that the reserves can be used to compensate for damages if the funds are still available when they are needed. In the case of insolvency, claims for damage to biodiversity will most likely have to compete with claims of other creditors, who may have priority in bankruptcy proceedings. For this reason, some consider self-insurance the riskiest of all financial securities options since no protection is provided from claims of creditors.[262] In addition to being a social and economic issue (the costs, in the end, being paid by society), it is equally an environmental problem if insufficient compensation is available for damage to biodiversity.

E. Risk-Pooling

1. Economic

From an economic perspective, risk-pooling requires members to pay a contribution (comparable to a premium), but the contribution does not necessarily need to be paid *ex-ante*. This means that if the risk does not

[262] *See* EUROPEAN COMMISSION, IMPLEMENTATION OF DIRECTIVE 2009/31/EC ON THE GEOLOGICAL STORAGE OF CARBON DIOXIDE: GUIDANCE DOCUMENT 4, 27 ("Certainty also depends on stringency of required financial tests.").

materialize, the premium is not "lost." This is different from insurance premiums, which are paid to an insurer irrespective of the occurrence of the damage.[263] Risk-pooling will mostly be available for relatively small homogenous groups. This helps to keep the administrative costs of a risk-pooling scheme relatively low. Moreover, the contribution to a risk-pooling scheme will often be lower than the premium paid to an insurer because operators mutually pooling their own risk generally have better information on the risk exposure than insurers. As a result, they do not need to charge an additional risk premium.

The economic effect of a risk-sharing scheme on users is that the costs will only be passed on once the damage materializes. Without damage, there would hardly be any costs, which constitutes a major advantage of risk-sharing, in comparison with insurance and compensation funds, both of which require an *ex-ante* contribution.

The need for homogeneity within the risk-pooling group would mean that a risk-pool of, for example, farmers or LMO producers could work, but not a mix of both. Within a group of specific operators, sub-groups may need to be created to maintain the necessary level of homogeneity.

2. Social

The homogeneity of the pool and the sharing of risks create solidarity among the pool members. Pools also need to be built in a way to facilitate monitoring among the members. One consequence is that risk-pooling schemes may be possible at the international level if the number of participants is small, for example, if a few developers of LMOs were to create a risk-sharing pool. Where the number of potential participants is large, for example, end-users such as farmers, a risk-pool would presumably only work at a national or even sub-national level. Risk pools of farmers could potentially be split into different pools for small- and medium-sized farmers. The pools could subsequently be differentiated by the type of LMOs used by the farmers.

If mutual monitoring functions well, a risk-pooling scheme leads to a fair distribution of costs. Members that constitute a higher risk would either have to pay a higher contribution or would be excluded from the group. Cross-subsidization or free riding can, therefore, be excluded from the risk-pool via

[263] Recall from the example of the oil pollution that risk-sharing between tanker owners (via the P&I Club) could take care of the first layer of compensation, but for amounts exceeding this first layer, the IOPC Fund (financed by oil receivers) intervenes. *See supra* Section III.D.3, E.3.

mutual monitoring. The exclusion of members engaged in particularly risky activities could potentially be problematic if no other financial security mechanism is available.

In many traditional communities in developing countries (where insurances are largely unattainable), implicit risk-pooling schemes do, in fact exist, and cover relatively small damage that occurs to the community.[264] The conditions for an effective risk-pool in those small communities are obviously met as these groups are relatively small, homogeneous, and have good tools for mutual monitoring, thus enabling them to control moral hazards and free-riding. However, whereas those risk-pools might have emerged in developing countries, for example, to cover agricultural damage, it is highly unlikely that the same would cover LMO-related damage to biodiversity given the unpredictability of the scale of the damage.

Given the need for a sufficient number of members for the risk-pooling scheme and the need for homogeneity within the group, the development of risk-pooling schemes that would cover third-party damage in developing countries would be possible, for example, for small groups of large farmers. In addition, global producers would be able to create a risk-sharing agreement that could equally cover third-party damage in developing countries.

3. Environment

Risk-pooling has a major advantage when it comes to prevention: as all members in the pool become collectively liable to contribute when the risk materializes, they have excellent incentives for mutual monitoring.

In principle, the funds available via a risk-pooling scheme can be used for restoring biological diversity. It is important to determine whether there is sufficient cover, whether it is possible to call directly on the funds available via the risk-pooling scheme, and whether the cover provided is formulated in such

[264] Risk-sharing among farmers emerged in many countries. For example, (a) in Burkina Faso, (b) in Ethiopia, and (c) in Tamil Nadu, India, local mutual pools to protect farmers via risk-sharing have been created. *See* Johannes Sommerfeld, et al., *Informal Risk-sharing Arrangements (IRSAs) in Rural Burkina Faso: Lessons for the Development of Community-Based Insurance (CBI)*, 17 INT'L J. HEALTH PLAN. MGMT. 147–63 (2002); Erlend Berg, Michael Blake & Karlijn Morsink, *Risk Sharing and the Demand for Insurance: Theory and Experimental Evidence from Ethiopia*, 195 J. ECON. BEHAV. & ORG. 236–56 (2022); Stefan Dercon et al., *Offering Rainfall Insurance to Informal Insurance Groups: Evidence from a Field Experiment in Ethiopia*, 106 J. DEV. ECON. 132–43 (2014); Jeroen Kingma, Agricultural Insurance in Developing Countries: An Introduction and a Case Study in Tamil Nadu, India (Nov. 13, 2007) (MSc Thesis, University of Amsterdam).

a way as to cover the restoration of biodiversity. The example of the P&I Clubs that have wide experience in covering oil pollution damage[265] shows that it is possible to use a risk-pooling scheme to reverse some damage to the environment.

F. Fund

1. Economic

A fund can be financed in various ways. If the fund is paid via general taxes, the fund would not generate any preventive effect. If the fund is financed through contributions paid by operators, there may be some possibility of relating the contribution to risk. In that case, contributions to a fund can be comparable to insurance premiums, as operators would *ex-ante* pay the contribution to finance the fund. Administrative costs of a fund can, in some cases, be larger than with insurance. Insurers may have more experience in differentiating risk and handling claims. Profit maximization may also drive insurers more to cost reduction than compensation funds administered publicly.[266]

2. Social

A fund is usually financed by operators creating a particular risk. To the extent that the contributions reflect risk, the financing of the fund could be considered fair from a distributional point of view. Free riding by high-risk operators could, in that case, be avoided. However, the fund manager may not always carefully distinguish high-risk versus low-risk operators, in which case high-risk operators are *de facto* cross-subsidized by low-risk operators. Compensation via a fund is often based on a lump sum and does not always provide compensation for the full extent of the liability. Victims may thus receive less than full compensation if payment takes place via a fund. However, funds often have standardized and simplified procedures that facilitate the submission and consideration of claims. This can be an advantage for claimants that lack resources and can also expedite access to redress.

Theoretically, one could imagine the creation of a fund in a developing country where importers of LMOs or the end users of the LMOs would pay contributions to cover future damage. In this respect, insufficient human

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265 *See supra* Section III.D.3.

266 Faure & Hartlief - *Compensation Funds*, *supra* note 166.

resources, the costs of the operation of the fund, the number of paying operators, and the number of payments required might add to the complexities of establishing an effective compensation fund. Another model is the creation of a global fund through an intergovernmental instrument, as has been done for oil pollution and nuclear damage.[267] Depending on who would pay the contributions to the fund and who could potentially benefit, this could be more or less socially equitable.

3. Environment

The environmental effects of a fund very much depend on whether the fund applies an effective mechanism of risk differentiation that is needed to create incentives for prevention. If the fund were to be financed via general taxes, there would be no preventive effect. If it were to be financed by operators (e.g., with a levy on the quantity of LMOs produced), there might be some effect, although usually, the fund does not relate the contribution to the individual risk of an operator.

If the fund is able to generate sufficient contributions, it could, in principle, be used to restore environmental damage. There are many examples of environmental funds at both the domestic level[268] and the international level,[269] which provide compensation for the costs of restoring environmental damage. Whether the fund would be able to finance catastrophic risks depends on the way it is structured and on the amount that it can generate.

CONCLUSION

This article described a selection of financial security mechanisms, their modalities of operation, and the entities that can provide financial security. It also considered the suitability of financial security mechanisms to cover the type of damage addressed by the NKLSP. In practice, many hybrid mechanisms have been developed, combining elements of more than one financial security mechanism.

The focus of the NKLSP on damage to biodiversity poses a number of challenges for financial security mechanisms. One problem is that there may be

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[267] *See supra* Section III.E.3.

[268] One example is the Superfund in the United States. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601–9675 (2012).

[269] *See*, e.g., IOPC Fund discussion, *supra* Section III.E.3.

high uncertainty, not only with respect to the probability of an incident but also with respect to the potential scope of the damage. This explains why self-insurance appears to be the only financial security mechanism currently available to cover the biodiversity damage addressed by the NKLSP.

A second problem is where first-party financial security mechanisms might be suitable for traditional damage caused by LMOs (e.g., damage to property), third-party financial security mechanisms may be required for damage to biodiversity. First-party financial security mechanisms do not fit very well for repairing damage to biodiversity as biodiversity is not generally attributed to an individual. As a result, third-party mechanisms could be more suitable. Third-party financial security has the advantage that the liable operator will pay for the financial security to cover damage. On the other hand, risk differentiation is more difficult for third-party cover than for first-party financial security.

Some financial security mechanisms require *ex-ante* payment, such as insurance premiums or contributions to a fund. Others may only require payment *ex-post*, for example, contributions to a risk-sharing agreement or payment out of internal reserves (self-insurance). This distinction is relevant given the uncertainty concerning both the probability and the scope of biodiversity damage. Given those uncertainties, *ex-ante* financial security mechanisms may be more problematic than *ex-post* mechanisms, as *ex-ante* mechanisms require information in order to calculate a premium or contribution. In a situation of high uncertainty, where an *ex-ante* determination of premiums/contributions might be difficult, *ex-post* mechanisms might generally be more suitable. Some *ex-post* mechanisms, however, bear the risk that the operator is insolvent at the time the damage occurs and, therefore, no financial security is provided. To mitigate this risk, guarantees are required to ensure, in the case of damage, compensation is available even in the case of insolvency of the operator.

From an environmental point of view, financial security mechanisms need to ensure that sufficient funds are available to cover the costs of repair (e.g., restoration). In addition, financial security mechanisms should provide incentives for prevention. These incentives are generally stronger in mechanisms that require *ex-post* contributions, given that participants are only required to fund the mechanism in case damage occurs. Self-insurance and risk-pooling would provide strong incentives for prevention. Prevention incentives should also be built into *ex-ante* mechanisms, for example, when insurance premiums differentiate according to risk profiles, and premiums are lower for those insured with a lower risk profile but are generally weaker than for *ex-post*

mechanisms. Financial security mechanisms that provide partial compensation could also provide an incentive for prevention, although, from an environmental point of view, this would not be optimal as the compensation may be insufficient. While the preventive effect can be an advantage of especially *ex-post* mechanisms, the incentive for prevention will be very much reduced if the liable operator becomes insolvent as a result of the damage. This is regarded as a danger of self-insurance, where each operator insures its own risk.

In order to keep the risk of damage low, most financial security mechanisms incorporate some form of monitoring, which is beneficial. Where some mechanisms rely on external monitoring (e.g., where an insurer monitors the activities of the insured), other mechanisms rely on mutual monitoring among the participants in the financial security mechanism. This is the case in risk-pooling, where mutual monitoring is very strong, especially where small groups of homogenous operators have the expertise needed to assess the practices of other pool members.

In terms of the social impacts of financial security mechanisms, this article pointed to the distributional effect of the various mechanisms. In the case of self-insurance, large operators would bear the cost of damage, as self-insurance would be an option only for those operators with sufficient resources to sustain the cost of damage. Risk pools distribute the cost of damage among relatively small numbers of homogenous operators. Risk pools can be established for various groups of operators in the supply chain as long as there is a sufficient level of homogeneity among the members of each risk-pool. As a result, risk pools allow the distribution of the cost of damage among different types of operators. For third-party insurance, the distributional effect would depend on who is insured. As insurance generally requires large numbers of insured, the distributional effect may be substantial. For funds, the distributional effects depend entirely on the arrangements made, which will determine which entities are to contribute to the fund. As operators are expected to pass on the cost of financial security in their products, the effect of the financial security mechanisms will be spread throughout the supply chain. This could have financial and economic effects, including for the end consumer, and may, depending on regulation, affect investment decisions. *Ex-post* mechanisms in a scenario without the occurrence of substantial damage would reduce this effect.

Furthermore, access to redress differs for each mechanism. Funds generally have streamlined procedures for handling claims that may ease access to compensation, although the payments made may be limited. Access to payments

under some third-party insurance policies requires an operator to be held liable, which may require a complex, lengthy, and costly process. Direct access for claimants to insurers could mitigate this issue.

Finally, this article identified possible providers of financial security for LMO-related damage to biodiversity in light of the suitability of the financial security mechanism. Given the uncertainties surrounding biodiversity damage, there is a high reluctance among insurers to provide cover, which makes it unlikely that insurers would be able to provide third-party liability cover for LMO-related damage to biodiversity. There may, however, be other providers of financial security (e.g., larger operators in the supply chain) who might be willing to provide financial security via either self-insurance or a risk-sharing agreement.

In that respect, governments could play a facilitative role in promoting financial security, including creating the enabling conditions for the development of a variety of financial security mechanisms. Moreover, it would be beneficial that information is shared on existing financial security mechanisms for damage to biodiversity.

In a number of developing countries, experience with financial security mechanisms exists, including informal mechanisms, such as *de facto* self-insurance as well as risk-pooling among farmers. The administrative, regulatory, and institutional challenges many developing countries face would likely exacerbate the general difficulty of developing financial security mechanisms to cover damage to biodiversity caused by LMOs. International practice shows, however, that with adequate regulatory support, transboundary financial security mechanisms can be developed in which operators in developing countries could also participate.

ANNEX: EXAMPLES OF EXCLUSIONS OF LMO-RELATED RISKS BY VARIOUS INSURERS

Insurer & Insurance type	Clauses excluding LMO damage in the insurance policies
DUAL Australia iTech Information Technology Wording (12/09), 2016	Section 8: Exclusions WE will not cover the INSURED, including for compensation, DEFENSE COSTS or other costs, expenses or loss, in respect of: . . . 8.19 Genetically Modified or Engineered Organisms (GMO) Any CLAIM or liability arising from or directly or indirectly attributable to or in consequence of the manufacture, importing, growing, blending, mixing or distributing of Genetically Modified or Engineered Organisms (GMO). For the purpose of this Exclusion, a Genetically Modified or Engineered Organism is defined to be a living plant, animal or microbe that has been altered by the addition or modification of a gene through the process of genetic engineering and contains genes or portions of genes from unrelated organisms.[270]
Winter Crop Insurance Terms & Conditions, Achmea Australia, 2018	General Exclusions What you are not insured for You are not insured for any loss or damage, actual or alleged legal liability caused by, arising from, or in connection with any of the following: . . . 14. any liability caused by Genetically Modified Organism (GMO), such as, but not limited to: a) claims attributable to the genetic instability, inadequate characterization or performance of GMOs, blending or contamination claims; or b) loss or damage resulting from the unintentional, non-agreed or improper blending or mixing of GMOs with other organisms or products, or their pollination by GMOs, pure

[270] CENTREWEST INSURANCE BROKERS, DUAL AUSTRALIA ITECH INFORMATION TECHNOLOGY POLICY WORDING, THE DUAL APPROACH: ITECH INFORMATION TECHNOLOGY 13, 16 (2016), https://www.centrewest.com.au/wp-content/uploads/2016/07/IT-Wording-12-09.pdf.

	financial and/or economic claims, environmental impairment, ecological damage, or damage to biodiversity.[271]
ICICI Lombard General Insurance Company limited, Product Liability Insurance	3. Exclusions . . . (xxv) Genetically Modified Organisms Exclusion - any actual or alleged loss of or damage to property or liability whatsoever, directly or indirectly caused by or resulting from or in consequence of or contributed to, by or arising out of existence, production, processing, manufacture, sale, distribution, storage, deposit, consumption or use of Genetically Modified Organisms ("GMOs"). For the purpose of this exclusion, GMOs shall mean and include: (i) Organisms or micro-organisms or cells, or the organisms or microorganisms, cells or cell organelles, from which they have been derived, which have been subject to a genetic engineering process which resulting in their genetic change, (ii) Every biological or molecular unit with self replication potential, or biological or molecular unit with self replication potential from which they have been derived, which has been subject to a genetic engineering process which resulted in its genetic change. In the event that the definition of GMO under the applicable laws and/or official regulations relating to genetic engineering or modification in any State, territory or jurisdiction in which a claim is made is wider than the foregoing then such wider definition shall be deemed to be a part of this definition in addition to the foregoing.[272]
PT Asuransi AXA Indonesia Redefining insurance, Smart Traveler	Exclusion: Except as set out in this clause, all coverage for claims in connection, or from dealing, with a GMO, a GMO product or product part with a GMO component is expressly excluded.

[271] ACHMEA AUSTRALIA, WINTER CROP INSURANCE TERMS & CONDITIONS 16 (2018), https://www.achmea.com.au/wp-content/uploads/2019/04/Winter-Crop-Insurance-Terms-Conditions-Version-C-5.0-2018.pdf.

[272] ICICI LOMBARD GENERAL INSURANCE COMPANY LIMITED, SPECIMEN POLICY DRAFT: PRODUCT LIABILITY INSURANCE 7, https://www.idfcfirstbank.com/content/dam/IDFCFirstBank/form-center/business-insurance/Policy-Draft-PDT-LIABILITY.pdf (last visited May 21, 2022).

	a. In particular, but not limited to, there shall be no coverage for claims arising from unintended, non agreed or improper pollination by, distribution of or blending with a GMO, a GMO product or product part with a GMO component. Definition: For the purposes of the insurance provided with this endorsement and of the exclusion expressed therein the term Genetically Modified Organisms (GMOs) shall mean and include: a. Organism or micro-organisms or cells, or the organisms or micro-organisms, cells or cell organelles, from which they have been derived, which have been subject to a genetic engineering process which resulted in their genetic change and shall also mean and include b. Every biological or molecular unit with self replication potential, or biological or molecular unit with self replication potential from which they have been derived, which has been subject to a genetic engineering process which resulted in its genetic change. In the event that the definition of GMO under the applicable laws and/or official regulations relating to genetic engineering or modification in any State, territory or jurisdiction in which a claim is made is wider than the foregoing then such wider definition shall be incorporated into this definition in addition to the foregoing.[273]
L&T General Insurance Company Limited, commercial general liability insurance policy, 2010	General exclusions: the company shall not provide indemnity in respect of, . . . 15. Claims and Loss, of whatsoever nature directly or indirectly caused by, in whole or in part arising out of, contributed to, resulting from or in connection with Genetically Modified Organisms and/or products.[274]

[273] PT ASURANSI SMART TRAVELER, AXA INDONESIA REDEFINING INSURANCE, https://axa.co.id/wp-content/uploads/axagi/download_center/file/Policy_Wording_SmartTraveller-bilingual-update-merged.pdf (last visited May 21, 2022).

[274] L&T INSURANCE COMPANY LIMITED, COMMERICAL GENERAL LIABILITY INSURANCE POLICY (2010), https://www.irdai.gov.in/ADMINCMS/cms/Uploadedfiles/21_CGL%20-%20Policy%20Wordings.pdf (last visited May 21, 2022).

Sun General Insurance, Machinery insurance policy Grenada, 2013	5.6 Genetically Modified Organisms This Policy does not cover: any liability, loss, cost or expense directly or indirectly arising out of, resulting from, caused or contributed to by GMOs. For the purposes of this exclusion the term GMO's shall mean and include: Organisms or micro-organisms or cells, or the organisms or microorganisms, cells, or cell organelles, from which they have been derived, which have been subject to a genetic engineering process which resulted in their genetic change. Every biological or molecular unit with self-replication potential, or biological or molecular unit with self-replication potential from which they have been derived, which has been subject to a genetic engineering process, which resulted in its genetic change. In the event that the definition of GMO under the applicable laws and/or official regulations relating to genetic engineering or modification in any province, State, territory, or jurisdiction in which a claim is made is wider definition in addition to the foregoing. This exclusion applies regardless of any other contributing or aggravating cause or event that contributes concurrently or in any sequence to the loss, damage, cost, or expense.[275]
LocalTapiola, liability insurance VY1, 2014	4.14 Special risks excluded from liability insurance Liability insurance shall not cover damage or costs that were directly or indirectly caused by any of the following substances, illnesses . . . genetically modified organisms (GMO).[276]

[275] SUN GENERAL INSURANCE, MACHINERY INSURANCE POLICY: GRENADA (2013), https://www.sungeneral.net/images/policies/machinery-breakdown/SPECIMEN-Grenada-Machinery-Insurance.pdf.

[276] LOCALTAPIOLA, COMMON TERMS AND CONDITIONS FOR LIABILITY INSURANCES VYI 2–3 (2014), https://www.kokairport.fi/files/6.