Study on Financial Security Mechanisms under the Nagoya-Kuala Lumpur Supplementary Protocol

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24/05/2021

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List of Abbreviations

BP	British Petroleum
CBD	Convention on Biological Diversity
CLC	Civil Liability Convention
CPB	Cartagena Protocol on Biosafety
CSC	Convention on Supplementary Compensation
CTP	Compulsory Third Party
ELD	Environmental Liability Directive
EPA	Environmental Protection Agency (US)
GCCF	Gulf Coast Claim Facility
GATT	General Agreement on Tariffs and Trade
GM	Genetically Modified
GMOs	Genetically Modified Organisms
GS	Geological Storage
IAEA	International Atomic Energy Agency
IOPC	International Oil Pollution Compensation
LMO	Living Modified Organism
NKLSP	Nagoya-Kuala Lumpur Supplementary Protocol
OPOL	Offshore Pollution Liability Association
P&I Club	Protection and Indemnity Club
SME	Small and Medium-Sized Enterprises
SPM	Sanitary and Phytosanitary Measures
TBT	Technical Barriers to Trade
WTO	World Trade Organization

List of Boxes

Glossary

Adverse selection: is the result of 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, as a result of which insurers remain stuck with high-risk individuals.

Co-insurance: is a cooperation between insurers to cover one larger risk by each providing a part of the coverage for this one particular project (for example four insurers each covering 25%).

Ex ante: this term is used to indicate a moment in time before the damage occurs.

Ex post: this term is used to indicate a moment in time after the damage occurs.

First party cover: is a financial security (scheme) providing cover to an individual (or firm) who is exposed to a particular risk (for example damage he/she suffers caused by LMOs), whereby the potential victim seeks him/herself financial security for that particular risk.

Free-riding: refers to a range of situations in which users of a particular service do not have to pay for them. If others can free-ride on the efforts of an operator, that operator may no longer have incentives to invest in those particular services.

Insurer ambiguity: is the uncertainty of insurers concerning either the probability of the accident occurring and/or the magnitude of the potential damage.

Moral hazard: is the tendency of an insured, receiving full insurance coverage, to increase the risk as the individual itself is no longer exposed to the risk, since this has been shifted to the insurer.

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) for a particular risk category (for example environmental liability).

Reinsurance: is insurance coverage provided by a reinsurer to an insurance company.

Risk-pooling: is a model whereby 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.

Third party cover: it is a financial security (scheme) providing financial security to cover the risk that an operator may have to compensate the damage suffered by a third party on the basis of her/her liability.

1. Introduction

In 2000, the Cartagena Protocol on Biosafety (CPB) was adopted. 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 (LMO) resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity. Article 27 of the CPB mandated the negotiation of international rules and procedures to deal with liability and redress for damage arising from such LMOs. After six years of intense and difficult negotiations,[1] the Nagoya – Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on biosafety (NKLSP) was adopted in 2010.[2] The NKLSP adopts 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 in transboundary movements.[3] As far as financial security is concerned, Article 10, paragraph 1, NKLSP provides that Parties retain the right to provide, in their domestic law, for financial security. Further, Article 10, paragraph 3, NKLSP provides that the first meeting of the Conference of the Parties serving as the meeting of the Parties to the Cartagena Protocol (COP-MOP) after the entry into force of the NKLSP 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.

In its decision CP-9/15, the COP-MOP gave effect to this provision. The present study was developed in response to decision CP-9/15 and in accordance with Article 10, paragraph 3 of the NKLSP. In preparation for the present study, the following sources were consulted: reports and studies prepared for the negotiations of the NKLSP,[4] available economic literature dealing with the various types of financial security available and literature outlining existing financial security mechanisms established for environmental harm (other than damage from LMOs[5]).[6]

Most of the literature with respect to the NKLSP dates from the period just after its adoption.[7] All relevant literature that could be found has been included, but since 2015 relatively little has been published on the

[1] So Nijar 2013, 272 and Lefeber & Nieto Carrasco 2014.
[2] For a further analysis of the liability regime in this NKLSP, see Nijar 2013, 271-290 and Liu 2019, 34-52. For a further analysis of liability and redress under the Cartagena Protocol, see Nijar 2008.
[3] So Nijar 2013, 289; Shibata 2014, 24-28 and Lago Candeira 2016.
[4] Including detailed studies concerning financial security for LMOs provided by international (re)insurance, such as for example https://www.cbd.int/doc/meetings/bs/bswglr-02/information/bswglr-02-inf-07-en.pdf and https://www.cbd.int/doc/meetings/bs/bswglr-03/information/bswglr-03-inf-05-en.pdf.
[5] One note on terminology: the NKLSP systematically refers to LMOs, whereas particular literature rather refers to GM or GMOs. As this study also relies on that literature using a different terminology, the terms LMOs and GMOs will be used interchangeably without adhering a particular importance to that difference.
[6] Such as for harm related to offshore oil and gas activities (Faure 2017) or for carbon capture and storage (Faure & Partain 2017).
[7] Legal aspects of implementing the Cartagena Protocol on biosafety are discussed in Cordonier-Segger et al. 2013; liability and redress under the Cartagena Protocol is discussed by Nijar 2008; the monograph edited by Shibata 2013 is devoted to the liability regime developed by the NKLSP. The most recent monograph devoted to legal aspects of GMOs (more generally) is the dissertation by Liu 2019.

NKLSP. Furthermore, many of the examples concerning financial security mechanisms established for environmental harm come from the European or the developed world context, as fewer examples from other regions were available.

The primary goal of this study is to sketch the modalities, including the advantageous and disadvantages of different financial security mechanisms. The structure is to an important extent determined by the topics to be addressed as identified in Article 10(3) NKLSP: after this introduction the study starts with a section addressing the risks to be covered in order to identify for which particular risks financial security is sought (section 2); section 3 will provide an overview of the modalities of potential financial security mechanisms and of the potential entities that could provide financial security. Section 4 provides an assessment of the economic, social and environmental impacts of the various mechanisms, with a specific focus on developing countries. Section 5 provides conclusions.

It is important to note that the type of damage on which the NKLSP focuses is primarily damage to biodiversity. However, most of the literature dealing with financial security for LMOs primarily focuses on traditional damage that would be suffered by non-GM farmers who are confronted with GM comingling.[8] Even though these examples may be less relevant for the biodiversity damage covered by the NKLSP, the examples will still be discussed in light of the scarcity of literature addressing financial security for damage to biodiversity covered by the NKLSP. Moreover, many of the examples covered in the literature deal with the use of LMOs in agriculture although the applications of LMOs are of course 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, however, be aware that the application of LMOs is broader than just in plants and agriculture and that the main focus of the NKLSP is on damage to biodiversity rather than property damage of farmers.

2. The risks to be covered

2.1 Goal

This section aims at explaining in simple terms what financial security is and what purpose(s) it serves and introduces a number of related terms and concepts.

2.2 Reasons for financial security[9]

Financial security can be seen as a mechanism to protect against risk. Risk can be expressed as the probability (likelihood) that an event which causes a particular damage might occur.[10] There may be various reasons why there would be a demand for financial security to deal with risk. The first reason is risk aversion. Individuals often have an aversion against risks with a potential high magnitude of damage, especially when that damage could endanger their entire wealth. Given the limited assets of most

[8] See for example Koch 2008.

[9] In the literature a variety of different terms are used to cover the same issue, such as *inter alia* "financial assurance" or "bonding requirements". See Mackie & Besco 2020, 10574.

[10] This goes back on Frank Knight's famous distinction between risk and uncertainty (Knight 1921).

individuals, a majority of the population is averse against risks and may seek financial security (for example insurance) to be protected from risk.[11]

A second reason for financial security is that in case of insolvency, operators may not be able to cover their potential liability exposure, as a so-called "judgment proof-problem"[12] would arise. The potential insolvency of an operator is problematic from two perspectives: first, it would imply that the remedies related to liability and redress cannot be executed (restoration cannot take place or victims will not be compensated); second, when an operator is insolvent, the preventive effect of liability rules will equally fail. More specifically, the duty imposed on the operator to compensate 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 harm. For those reasons, the legislator can impose an obligation to seek financial security on the operator when there is a danger of insolvency.[13] Financial security is thus important 1) to guarantee victim compensation and 2) to provide incentives for prevention to the operator.

2.3 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. They may also arise under Article 12, related to civil liability, depending on domestic legal frameworks, as set out below.

With regard to response measures, in general terms, the NKLSP obliges Parties to impose duties on an operator to evaluate damage and take response measures (see box 1 for more details). These response measures are defined in Article 2 as reasonable actions to prevent, minimize, contain, mitigate or otherwise avoid damage as appropriate and to restore biological diversity.[14] These response measures can lead to costs for which the operator may seek financial security.

Box 1: Key provisions from Article 5 of the NKLSP

Article 5. Response measures

1. Parties shall require the appropriate operator or operators, in the event of damage, subject to any requirements of the competent authority, to:

(a) Immediately inform the competent authority;

(b) Evaluate the damage; and

(c) Take appropriate response measures.

[11] Arrow 1963, 1965.
[12] Referring to the fact that 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 generally Shavell 1986.
[13] Faure 2006; Jost 1996 and Polborn 1998.
[14] As further defined in Article 2(2)(d)(ii) of the NKLSP.

3. Where relevant information, including available scientific information or information available in the Biosafety Clearing-House, indicates that there is a sufficient likelihood that damage will result if timely response measures are not taken, the operator shall be required to take appropriate response measures so as to avoid such damage.

4. The competent authority may implement appropriate response measures, including, in particular, when the operator has failed to do so.

5. The competent authority has the right to recover from the operator the costs and expenses of, and incidental to, the evaluation of the damage and the implementation of any such appropriate response measures. Parties may provide, in their domestic law, for other situations in which the operator may not be required to bear the costs and expenses.

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.[15] Article 12 establishes a right for Parties to address damage resulting from LMOs through civil liability rules and procedures. Civil liability for material or personal damage is only covered by the NKLSP to the extent that it is associated with biodiversity damage as defined in Article 2(2)(b).[16] The specific contents of the liability provision will depend upon the way in which domestic law has implemented the various aspects of Article 12.[17] A demand for financial security can therefore also emerge to cover the risk of liability under domestic law in the implementation of Article 12.

2.4 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). 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 whereby the potential victim seeks financial security for that particular risk. In this situation, the financial cover is directly provided to the person or entity exposed to the risk and as a consequence that entity will also pay (for example 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 the damage suffered by a third party on the basis of the liability of the operator. That is referred to as a third party cover as it is not the potential victim who directly seeks financial cover, but the financial cover is rather provided for the case that an operator will be liable to cover the damage suffered by a third party (the victim). A liability insurance is a typical example of third party cover.

The difference between first party and third party cover is of importance as some claim that it is easier to provide first party cover than third party cover[18] and there are obvious distributional differences as well:

[15] Nijar 2013, 277.
[16] Nijar 2013, 274.
[17] See Nijar 2013, 276-277; Telesetsky 2011 and Jungcurt & Schabus 2010, 201-202.
[18] An argument especially developed by Priest 1987.

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; 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).

In the context of LMOs, there could potentially be both first party as well as third party cover.[19] 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.

A challenge for this study arises in that most of the literature on financial security for LMO-related damage[20] deals with comingling and the adventitious presence of LMOs in agriculture, thus leading to property damage for a farmer. That explains why most of the literature dealing with financial security for LMOs discusses first party rather than third party mechanisms.[21] 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.

2.5 Potential damage and risk scenarios

The NKLSP covers damage to biodiversity on the condition that it is measurable or observable taking into account available scientifically established baselines recognized by a competent authority.[22] The damage must, moreover, be significant. Article 2, paragraph 3, of the NKLSP provides criteria to determine whether a particular adverse effect is significant. The problem with seeking financial security for damage to biodiversity is that the damage can appear under a wide variety of different risk scenarios.[23] This can lead to two related issues with the provision of financial security: (1) because LMOs can cause harm under a wide variety of different risk scenarios, it is at present difficult to assess whether currently existing financial security mechanisms (for example insurance) do provide cover for a specific type of damage to biodiversity caused by LMOs,[24] and; (2) this may equally make it difficult to develop dedicated financial security in the future as there is a wide variety of possible scenarios leading to damage.

2.6 Uncertainty

In the case of the potential damage related to LMOs, there may not only be a risk, but also uncertainty.[25] Risk indicates that there is a probability (for example 10, 30 or 50%) that an event leading to damage will occur. There is a risk, but the probabilities are known. In case of uncertainty, the probabilities are simply

[19] See further on the relevance of the distinction between first party and third party cover for LMOs, CBD Secretariat 2007, 2-3, with a discussion of the position of insurers in that respect.
[20] For example Koch 2008.
[21] See for example Ebert & Lahnstein 2008.
[22] Art. 2(2)(b); Nijar 2013, 273.
[23] Also during the negotiations preceding the NKLSP, different damage scenarios were reviewed. For a discussion see Nijar 2013, 283.
[24] This may depend upon 1) the type of loss; 2) cause of loss; 3) alleged wrong; and 4) the manner in which the coverage was written, so Roberts 2020.
[25] Koch 2008, 616, No. 117.

unknown.[26] The uncertainty for financial security providers relates to two issues. There is in the first place uncertainty concerning the potential impacts of LMOs. Second, there is uncertainty concerning the LMO civil liability regimes as they depend upon implementation in domestic law.[27] These issues make financial institutions reluctant to cover LMO-related risks.[28] These uncertainties were equally largely recognized during the process leading to the NKLSP. A 2003 conference report on biotechnology by Swiss Re mentions that the risk posed by GM crops are estimated to be very low, but that there remains uncertainty with regard to allergenicity, fitness and the impact of such crops on wildlife.[29] Notwithstanding the estimated low probability, the insurers are still reluctant to cover LMO-related risks. The reason is precisely that even with a low probability there can still potentially be high damage or at least there is uncertainty with respect to the scope of the damage. Uncertainty and complexity may very well increase in view of the rapid evolution of biotechnologies.[30]

2.7 Transboundary scope

The NKLSP applies to biological diversity damage resulting from LMOs that find their origin in a transboundary movement.[31] The financial security mechanisms presented in this study were selected based on their suitability in that context.[32]

2.8 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 of LMOs, producers, exporters, importers and distributors may face different exposure to liability and may need different types of financial security.[33] Parties have discretion to decide who is the operator liable according to domestic law. As the determination of 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.[34] For now, it suffices to state that the 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.

[26] See on the difference LeRoy & Singell 1987.
[27] Telesetsky 2011.
[28] Jungcurt & Schabus 2010, 204; James 2008.
[29] International Biotechnology Forum 2003, 12 (included in Annex B to CBD Secretariat 2006).
[30] Ibidem.
[31] Article 3(4) NKLSP.
[32] Whether the LMO causing the damage found its origin in a transboundary movement, may be very difficult to verify in practice.
[33] See also Koch 2008, 615-618; Nijar 2013, 276.
[34] Telesetsky 2011. She refers to the market distributor, the scientific developer and the transporter of the LMO.

3. Financial security mechanisms

3.1 Introduction

This section describes the modalities of several financial security mechanisms, providing for each: (i) a description of the mechanism; (ii) the conditions that must be fulfilled for the mechanism to work; (iii) examples, where available, of the existence of the mechanism for damage from LMOs and environmental harm; (iv) an analysis of the suitability of the mechanism to provide adequate compensation and incentives for prevention and (v) 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 study focuses on a selection of more widely explored and practical financial security mechanisms, while also giving some consideration to alternative financial security mechanisms.

This study will focus on the following mechanisms that will be reviewed in more detail:

- (re)insurance;
- self-insurance;
- risk-pooling;
- funds.

For each financial security mechanism the appropriate entities that could provide the financial security will also be identified.[35] Section 3.6 will briefly discuss a few other financial security mechanisms that are considered less suitable for covering LMO-related damage.

3.2 (Re)Insurance

3.2.1 Description

Insurance in its most simple form is a mechanism whereby a particular risk is shifted by the party exposed to that risk (the insured) to a another entity (the insurance company). The reason an insurance company can take over the risk is the law of the large numbers: because a large number of individuals exposed to a similar risk can be pooled together in a risk pool, the insurer can spread the risk.[36]

As explained in section 2.4 above, there is an important distinction between first party insurance (whereby the insured is covered for his own loss) and third party insurance (whereby damage inflicted by the insured on a third party is covered). First party insurances can therefore theoretically provide cover, for example to farmers against consequences of risks such as natural disasters like hail or storms.[37] 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.[38]

[35] In line with Article 10(3)(c) of the NKLSP.

[36] Koch 2008, 615, No. 116. The idea is that insurance allows for a spreading of the risk over the entire group of insured. All the insured in the risk-pool share the risk by paying the insurance premium. The sum of all the premiums together will allow to compensate the insured who suffers a loss, i.e. the insured risk.

[37] Koch 2008, 618-620.

[38] Koch 2008, 617-618.

3.2.2 Conditions

Theoretically, many conditions need to be fulfilled for a particular risk to be insurable.[39] A crucial condition is that a sufficiently large amount of insured should 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 can be 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.

Moreover, insurers need to have sufficient information to be able to calculate a premium. In most simple terms, the premium is the result of the multiplication of the probability and the potential compensation due. That constitutes what is called the actuarially fair premium. In order to determine the probability with known risks, the insurer relies on statistics. Statistics are usually derived from past damage and risk histories. 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". In that case, to some extent modelling and risk assessment models could be used. However, insurers may have doubts when there is little information with respect to the risk and also 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.[40] In some cases, there may be a different perception of the risk between for example an operator seeking insurance coverage and considering 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 should be a demand for insurance. As a result of a wide variety of problems, such as for example lacking financial affordability (for example small farmers being unable to pay the premium for agricultural insurance), unawareness of the risk or psychological biases, such as an "it will not happen to me" attitude, such a demand may not emerge. For insurability it is thus essential that (i) insurance premiums are affordable and (ii) insured persons are aware of the risk. When the demand for insurance for LMO-related risks would be small, this could be a hurdle to insurability.

Another condition of insurability is that the problems of adverse selection and moral hazard have to be addressed.[41] 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 would only attract those high risks, uninsurability would arise.[42] Moral hazard refers to the tendency of individuals receiving full insurance coverage to increase the risk, as they are themselves no longer exposed to risk, since this has been shifted to the insurer.[43] In order for a risk to be insurable, insurers need to ensure that their policies are sufficiently differentiated for risks. This practice would result in fully distinguishing between the various risk types so that lower risk is rewarded with a lower premium. This would allow insurers to remedy adverse selection. Insurers could also impose policy conditions, such as

[39] Conditions of insurability have been discussed in the literature (Faure & Hartlief 2003, 81-120) and also in the framework of the preparations of the NKLSP these conditions have been mentioned (CBD Secretariat 2006, 10).
[40] Kunreuther, Hogarth & Meszaros 1993.
[41] Also discussed in detail *inter alia* in CBD Secretariat 2006, 4.
[42] Because in that situation adverse selection and the well-known market for lemons would emerge (Akerlof 1970) and, applied to insurance, Priest 1987.
[43] Shavell 1979.

experience rating, to deal with moral hazard. Without the required differentiation and appropriate policy conditions, adverse selection and moral hazard could undermine the insurability.[44] Risk differentiation is easier with first party insurance policies than with third party insurance. The reason is that under first party, the insurer can exactly know the insured person and may thus have a better idea of the risk. 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.[45]

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.[46] An important condition on the supply side is therefore that there is sufficient capacity to deal with the risk. Capacity refers to the need to have sufficient funds available to compensate the losses once an accident occurs. Especially for relatively new risks (like LMOs), there may be a relatively small number of insurers willing to offer sufficient cover at competitive prices.[47] Not only demand, but also sufficient supply is therefore a crucial condition of insurability.

3.2.3 Practice

There are diverging messages about the availability of insurance to cover LMO-related risks. In a comparative overview, Koch held (in 2008) that neither first party, nor third party cover for LMO-related risks would be available.[48] Other reports have also indicated that insurance companies in EU Member States would decline to insure against any damage caused by GMOs.[49] Some more recent reports refer to particular insurances that would not explicitly exclude GMOs,[50] but a note of caution applies as these examples may be falling outside the type of damage as defined in the NKLSP. There are, however, a few reports indicating that some insurers, jointly with operators and policy-makers, try to develop insurance products that could, under particular conditions, cover LMO-related harm. For example, in the US, an insurance for genetic harm to organic crops was proposed in a report of the department of agriculture's advisory committee on biotechnology.[51] Another recent study conditionally proposes crop insurance

[44] Koch 2008, 615: the insurer should tailor the policies according to the various aspects of the risk, ideally with respect to each insured.

[45] See on this point especially Priest 1987.

[46] 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 (for example four insurers each covering 25%) for this one particular project. Re-insurance is insurance coverage provided by a reinsurer to an insurance company. See Faure & Hartlief 2003, 88-106.

[47] Faure & Hartlief 2003, 222-225.

[48] Koch 2008, 617-620.

[49] Genschäden nicht versichert (Genetic damaged not insured) Bauernstimme 01/2004, 14; Genethischer-Informationsdienst 160, Oct./Nov. 2003, 34.

[50] 2016 IRMI AgriCon, Overview of ISO New Farm Program, available at https://www.irmi.com/docs/default-source/afis-handouts/overview-of-isos-new-farm-insurance-program.pdf?sfvrsn=8 (last accessed on 1 October, 2020).

[51] USDA Advisory Committee on Biotechnology and 21st Century Agriculture (AC21), Enhancing Coexistence: A Report of the AC21 to the Secretary of Agriculture, November 19, 2012, https://www.usda.gov/sites/default/files/documents/ac21_report-enhancing-coexistence.pdf (last accessed on 06 October, 2020). It is, however, unknown whether that proposal has been taken up by the market.

policies that may respond to some potential LMO-related losses.[52] A farm insurance program in the US (2016) provides multiple coverage for a wide variety of property types, whereby the use of LMOs is not explicitly excluded.[53] Also a large reinsurer has developed the *biodiversity and ecosystem services* (BES) index which could assist insurers in developing policies equally covering harm to biodiversity.[54] The primary goal was to make sure there is a better understanding of biodiversity and ecosystem (service)-related risks worldwide, so that those risks can be calculated in business decisions and that calculating premiums by insurers would be possible.

Although more recent developments indicate at least an increased interest in developing insurance for some form of LMO-related harm, generally there are still important limitations.[55] Most of those are related to the specific features of LMOs, as a result of which many argue that the basic conditions of insurability, mentioned in the previous subsection, are not met or not entirely met.[56] 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 risks not to meet the requirements of insurability is that many policies largely exclude LMO-related risks.[57]

One important reason often mentioned for the exclusion of liability for LMO-related risk, is that there would be too much uncertainty concerning the scope of liability for LMOs.[58] What is considered especially problematic from an insurability perspective is that in some jurisdictions, GMO farmers are forced to compensate harm suffered by a non-GM farmer (consisting of non-GM crops no longer being marketable as such), even without a proof of causality.[59] While this would obviously highly increase the chances of a non-GM farmer to obtain compensation, it would also *de facto* convert the risk of the insured to be held liable into almost certainty, which reduces the insurability.[60] An important condition for insurers to cover

[52] Casey Roberts, GMO: a primer of sorts, IRMI, May 2020, available at https://www.irmi.com/articles/expert-commentary/gmo-primer (last accessed on 05 October, 2020).

[53] 2016 IRMI AgriCon, Overview of ISO New Farm Program, available at https://www.irmi.com/docs/default-source/afis-handouts/overview-of-isos-new-farm-insurance-program.pdf?sfvrsn=8 (last accessed on 1 October, 2020); Chris Berry and Dwight Aakre (2015), Utilizing a Farm-owner's Insurance Policy to Manage Risks to Farm Property, the document was prepared in by the University of Louisiana at Monroe's Small Business Risk Management Institute and Department of Agribusiness, available at https://farmanswers.org/Library/OpenItem/5345 (last accessed on 1 October, 2020).

[54] Swiss Re, A fifth of countries worldwide at risk from ecosystem collapse as biodiversity declines, reveals pioneering Swiss Re index, 23 September 2020, available at https://www.swissre.com/media/news-releases/nr-20200923-biodiversity-and-ecosystems-services.html (last accessed at 06 October, 2020). Christian Mumenthaler, Swiss Re's Group Chief Executive Officer once said that '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.'

[55] For a summary of the requirements of sustainability, see CBD Secretariat 2006, 2-5; Swiss Re, The Insurability of Ecological Damage, 2004, 27-29 (included in Annex B to CBD Secretariat 2006).

[56] Koch 2008, 616-617; Davenport 2006, 61; Ebert & Lahnstein 2008, 577.

[57] See Ebert & Lahnstein 2008, 577 and Koch 2008, 616, No. 118.

58 Ebert & Lahnstein 2008, 578, No. 4 and Koch 2008, 617.

[59] So Ebert & Lahnstein 2008, 577, No. 1 and 578, No. 4.

[60] Koch 2008, 617, No. 122.

third party liability would therefore be that a causal relationship is still required between the harm suffered and the presence of LMOs.[61]

It is also striking that insurance policies usually generally exclude all LMO-related risks and not just risk or harm to biodiversity. This is notable as the intrinsic difficulty to insure LMO-related damage is probably different, depending on the type of damage that should be insured. For example, the information on damage resulting from co-mingling should be predictable (and therefore one can understand that some careful steps towards at least considering covering those risks are made) while damage to biodiversity might be much harder to cover. Some examples of insurance policies excluding LMO-related damage are provided in Annex 1.

3.2.4 Analysis

If all of the previously mentioned conditions of insurability could be met, insurance can, theoretically, provide compensation both of (first party) damage to the insured and (third party) damage to victims. The entity providing insurance is the insurance company, complying with applicable regulatory requirements. Insurers are professionals in covering risks and handling claims.[62] 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 LMO-related harm, it may not be easy to satisfy the conditions of insurability. The basic problem is that the risk is relatively new, and little is known, neither about the probability of harm nor about the potential magnitude of the damage. The limited information makes the calculation of a premium very hard. Moreover, the number of players on the market that demand insurance may be limited (for example a small number of developers requiring third party insurance), as a result of which the large numbers 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 would be 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 cover (for example by including a risk premium to deal with insurer ambiguity), it is not certain that that will correspond with demand. Moreover, the insurance cover provided can be limited as a result of which there may be a need for additional instruments to cover the amount of the damage not covered by insurance.

3.2.5 Role of government

Insurance not only provides incentives for prevention, but also provides adequate compensation. However, the adequacy of the compensation will depend upon the capacity that can be provided on the market by (re)insurers. Increasing the capacity depends in the first place upon the willingness of insurers and reinsurers to provide cover, also for the risk of large damage. There are, however, various steps that

[61] Shifting the risk of causal uncertainty to an operator and his insurer has generally been considered as a cause of uninsurability. See Faure & Hartlief 2003, 125-126 and Katzman 1988, 89-90.
[62] Koch 2008, 615, No. 166.

the government could take in stimulating the insurability of LMO-related risks. A first possibility is to have the government improve the shape of the liability regime for LMO-related risks in order to provide more certainty concerning the scope of liability. Clear standards with respect to the liability regime can facilitate its insurability. The regulator could for example determine whether a strict or a fault-based liability applies, but also what type of response measures the operator should undertake. This could provide more insights into the potential extent of the damage. A second point is that insurability of LMO-related losses requires clear standards concerning good professional practice.[63] The Cartagena Protocol sets out a framework for assessing the risks of LMOs to biodiversity and further guidance on this framework has also been elaborated.[64] 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, in other words by providing a financial cap on the liability. This is explicitly provided as an option in Article 8 of the NKLSP. A statutory financial cap could facilitate insurability as it can provide an indication to insurers concerning the maximum amount of their 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.

Often, a financial limit on the liability is introduced in connection to the introduction of mandatory liability insurance.[65] However, the legislator could impose a duty to seek financial security up to a particular amount but keep the liability itself unlimited.[66] A classic example constitutes 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 they may cause.[67]

One final role for the government might be related to the potential catastrophic nature of the loss. Losses of a very high magnitude may not be insurable to the full extent, not even on the reinsurance market. One can increasingly notice that in those cases the government sometimes intervenes as reinsurer of last resort, thus stimulating insurance cover.[68] To the extent that LMO-related harm might be catastrophic and (re)insurance cover for catastrophic damage could not be acquired, this is a possible role for the government that could be considered. It is now often employed with natural hazards as well as with insurance of terrorism.

[63] So Ebert & Lahnstein 2008, 577-578 and Tung 2014.
[64] See Annex III of the Cartagena Protocol as well as the "Guidance on Risk Assessment of Living Modified Organisms and Monitoring in the Context of Risk Assessment", document UNEP/CBD/BS/COP-MOP/8/8/Add.1.
[65] Which will be further discussed below in 3.7.
[66] Faure & Hartlief 2003, 97-106.
[67] Faure & Hartlief 2003, 97-101.
[68] See further Bruggeman, Faure & Fiore 2010; Bruggeman, Faure & Heldt 2012.

3.3 Self-insurance

3.3.1 Description

Self-insurance is a term often used to refer to corporations using their own assets (their internal reserves) to cover future losses. In a technical sense it is therefore not to be considered as "insurance" as there is no risk-spreading, no risk-distribution and hence no loss-spreading after an accident happens.[69] It is a mechanism whereby operators use their balance sheet to guarantee payment for large losses. Using reserves does allow a risk-spreading in time, but not between various parties exposed to risk. A related notion is the so-called "captive", which is an instrument in the form of an insurance company that is created by an operator. 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) as that would also incur costs.

3.3.2 Conditions

The only essential condition for self-insurance to function is that the operator must have reserves available sufficient to cover future losses - either its own losses (first party) 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.

3.3.3 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 which we discussed in the previous section, 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 (for example importers of LMOs) or small holders like farmers or other end-users.[70]

Internal reserves are also used in relation to other types of environmental harm, more particularly in the energy sector.[71] For example, major oil companies use their own reserves as financial security to cover losses related to offshore drilling. As they consider all other alternatives (including insurance) relatively costly, they prefer self-insurance as it does not lead to additional costs unless the damage occurs.[72] Major oil and gas companies for example largely use self-insurance to hedge offshore-related risks.[73] Even smaller operators may use self-insurance as a so-called retention (or deductible) whereby coverage (for

[69] So Faure & Hartlief 2003, 144.

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

[71] Self-insurance is allowed in various jurisdictions for nuclear power plants, oil and gas companies and coalmine operators. See Mackie & Besco 2020, 10575, note 22 and Mackie & Fogleman 2016, 298.

[72] Faure & Wang 2017, 238-239.

[73] Faure & Wang 2017, 238.

example from an insurer) would only be required for amounts beyond the carrying power of the particular operator.[74] Self-insurance can also be used for operators of a geological storage site for carbon dioxide according to Guidance Document 4 implementing EU Directive 2009/31/EC on the geological storage of carbon dioxide.[75] Self-insurance is equally mentioned in the US EPA Financial Responsibility Guidance Document with respect to geological sequestration of carbon dioxide.[76]

Box 2: OPOL

The Offshore Pollution Liability Association (OPOL) is one example 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. Operators are liable for the harm 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 US$ 250 million. To cover these obligations, the operator has to comply with the rules for establishment of financial responsibility. One way of proving financial responsibility is by a qualification as self-insurer, by providing a financial statement meeting certain strict criteria. For example, an operator can qualify as self-insurer under OPOL only if it has a high credit rating from certain credit rating agencies.[77] Each operator which is a party to OPOL must provide satisfactory evidence of its ability to meet any liability under OPOL which is verified by OPOL. The experience with OPOL shows that, on the condition that stringent rules apply to control whether a particular operator can qualify as self-insurer, self-insurance could also function in a model of mandatory financial security.[78]

3.3.4 Analysis

Self-insurance will usually be used by entities with sufficient assets which do not fear that the scope of LMO-related harm 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 harm suffered by third parties. Those are entities with balance sheets comparable to other security providers (for example insurance companies) and for whom shifting risks to a third party (like an insurer) would consequently only lead to additional costs and not to 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 guarantees for future losses and do not have to transfer risks to an insurance company, which may create additional costs. Self-insurance usually does not create any costs

[74] Faure & Wang 2017, 240.

[75] It is, however, considered one of the riskiest options because there is no protection provided from claims of creditors. The document therefore holds "Certainty also depends on stringency of required financial tests".

[76] "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" (US EPA Geological Sequestration of Carbon Dioxide, Underground Injection Control (UIC) Program). For a discussion see Faure & Partain 2017, 169-170.

[77] 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.

[78] See further on OPOL, Faure & Wang 2015.

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 on the balance to cash only when the accident occurs.[79] Self-insurance does not involve a moral hazard[80] risk, as operators will still remain exposed to risk (and liability) (assuming the ability of the operator to compensate for the harm, 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 case of bankruptcy (for example 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 an externalization of risk (shifting costs to society) in case of insolvency.[81] If the operator is insolvent and there is no money available for environmental restoration, it would mean that either the state pays (and thus the tax payers) or that 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) that those will actually be used for the potential losses for which they were earmarked.[82] If those conditions can not be met, there is a danger that self-insurance may not be a mechanism that provides adequate financial security: in case of insolvency, the trustee in bankruptcy would collect the assets and the money would not be available to compensate for LMO-related harm.[83]

As far as compensation is concerned, self-insurance may work as a first party cover (covering the potential losses an operator may suffer itself) but is more problematic for harm to a third party (in case of insolvency). 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.

Normatively it should be repeated that self-insurance should only be used as financial security by well-capitalized larger stakeholders. In practice, however, one may observe that 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 as 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.

3.3.5 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, mandatory financial

[79] This can obviously lead to the need to sell assets (like real estate) at a lower price to provide the necessary cash.
[80] See on the concept of moral hazard *supra* 3.2.2.
[81] 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 tax payers" (Malone & Winslow 2019, 4; Mackie & Fogleman 2016, 296; Mackie & Besco 2020, 10583-10585).
[82] As will be explained in the next subsection, this is precisely what should be guaranteed in regulation.
[83] "When an operator self-bonds and files for bankruptcy, there is often little to zero funds for reclamation", so Malone & Winslow 2018, 4 and Mackie & Besco 2020, 10575.

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. 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 can be avoided that major operators would be forced to shift the risk to an insurance company, even when for example the credit rating of the operator would be higher than that of the insurance company.[84]

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 losses and that the self-insurance offered by the operator is adequately controlled. The example of OPOL (see *supra* box 2) 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 losses when they occur. 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 losses. Another example would be the case of BP which, after the accident with the Deepwater Horizon in the Gulf of Mexico, was able to raise 20 billion USD solely based on self-insurance.

3.4 Risk pooling

3.4.1 Description

Risk pooling is a model whereby 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. Suppose that 100 operators would each face a 1% probability of being exposed to a risk (for example losing a crop as a result of a storm) which could create a loss of 100.000 during a period of, say, 1 year. Risk aversion might inhibit the operators from engaging in the activity altogether as the land may be the only asset they possess which would be exposed to the relatively high risk (1%) of a total loss. The operators in this example could mutually share each other's losses by agreeing *ex ante* that each pays 1.000.[85] By taking the certain loss of 1.000, operators have traded risk and removed risk aversion. Once the risk materializes, 100 x 1.000 = 100.000 is available to cover the loss.[86]

The essence of such a risk sharing agreement is that there is no shifting of risk to a third party (like an insurance company), 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 losses occur (for example in case of tanker owners pooling the risk of liability for oil pollution damage). In that case, the likelihood that the pool has to pay depends to some extent on the safety

[84] Faure & Partain 2017, 169.

[85] 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.

[86] See on the basic features of risk sharing, Skogh 1999.

measures employed by each member to reduce the risk. This gives the members of the pool strong incentives towards mutual monitoring of safety. Managers of the pool will strictly check that the pool members do not take unreasonable risks in order to prevent members in the pool from free-riding. If one pool member would create higher risks than others, its contribution to the pool would increase to account for this higher risk. That should give that particular member an incentive for prevention. If the risks created by one particular member would be very high (and there would thus be heterogeneity between the pool members), it is most likely that member would be excluded from the pool to exclude the risk of free-riding on the other pool members.

Box 3: Risk sharing agreements versus pooling by insurers

The concept of "pooling" is used for two mechanisms which should be carefully distinguished. There is on the one hand a pooling of risks by insurance companies. In that case, insurance companies exclude competition to deal with a particular risk and bring all capacity 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 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 the nuclear risk. Nuclear power plants can therefore only obtain insurance from the pools. In some countries, also 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.

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.[87]

3.4.2 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 is in contrast to insurance which, as explained above, needs a large number of insured to be feasible.[88] Risk pooling generally requires an orchestrator taking 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.

[87] See further Faure & Hartlief 2003, 90-92.
[88] See 3.2.2.

Note, however, that (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 is sufficient. That explains why risk pooling may be relatively attractive for new risks where insurers may lack the statistical information needed to calculate premiums.[89] 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. That implies that if no losses would occur in one year, the subsequent year a lower contribution or even no contribution at all could be charged.

3.4.3 Practice

To the best of this author's knowledge, 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 3.7. 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 insurances (i.e. first party cover providing farmers with financial protection against losses from natural events such as drought, hail, wind, etc.) are constructed as risk-pooling schemes.[90] To the extent that those schemes do not exclude damage related to LMOs, that could be considered as an (implicit) LMO risk pooling scheme.[91] 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.[92] Although these contractual arrangements may provide for an *ex ante* arrangement of potential harm (and in that sense also for financial security), there is no risk-spreading and formally those contractual solutions can therefore not be qualified as a risk-pooling.

Box 4: Domestic level

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.[93] Those models sometimes foresee a payment by

[89] See further on the differences between insurance and risk sharing, Liu & Faure 2018, 258-260.

[90] Agricultural insurances may show a wide variety of governance models. In some cases it would be 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 the discussion of hybrids in section 3.7 below.

[91] We have just not seen any explicit trace of those in the literature, but it can certainly not be excluded that they do exist.

[92] Koch 2008, 633, No. 192.

[93] An excellent overview is provided by Koch 2008, 629-634.

operators meant to cover potential losses, but in those cases there is no voluntary risk-sharing, but simply a levy that has to be paid on a statutory basis.[94]

In several other domains, risk-sharing agreements have emerged to cover environmental risks. The most prominent example is probably the risk-sharing in the maritime sector provided by the so-called Protection and Indemnity Clubs (P&I Clubs). Those are mutual insurance associations established by ship owners and charterers to cover third party liabilities related to the use and operation of ships. The several P&I Clubs have joined their forces in an international group of P&I Clubs. They play an important role, for example in covering liability for oil pollution damage created by tankers.[95] The P&I Club monitors the preventive efforts of all individual members and will for example exclude the (more risky) so-called single-hull tankers. At the beginning of a year, a call is made requiring a contribution (comparable to a premium in the case of 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 or, in the alternative, if more accidents happen than expected, an additional call could be made. The P&I Club can thus adapt contributions in a flexible manner.

Pools have also been created to cover damage related to the nuclear risk[96], for damage resulting from offshore oil and gas drilling[97] and risk-sharing is equally applied on a large scale to cover damage related to fisheries in China. The damage relates *inter alia* to losses 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 on 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 working of the various risk-sharing agreements.[98]

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.[99] The problem with offshore drilling risk was related to the difference in size of the various operators. That implies that a hypothetical risk-sharing scheme between operators of similar size, for example between developers of LMOs, might work. To 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 to bring the parties together to create the risk pool. In some cases where risk-sharing between fishermen would be a viable option to

[94] An example constitutes a compensation model developed in Denmark. The model involves all stakeholders dealing with LMOs, but there is no sharing of risk. See further Koch 2008, 633-634. See further 3.5.3.
[95] Liu & Faure 2018, 264-266.
[96] Liu & Faure 2018, 267-269.
[97] Faure & Wang 2017, 261-262.
[98] For details, see Jiang & Faure 2020.
[99] Faure & Wang 2017, 261-262.

deal with risk, the risk-sharing scheme did not emerge because an orchestrator to take the initiative was lacking.[100]

In some cases, an outside trigger was the necessary catalyzer for the establishment of a risk-sharing agreement, for example an an accident that triggered others to establish a risk-sharing agreement aiming at the prevention and compensation of losses. In practice, it is often a regulatory duty (to seek financial security) which acts as the trigger to create a risk-sharing agreement.[101] The risk-sharing arrangement can then be used to meet the regulatory duty to seek financial security.[102]

Box 5: the Compact

The Compact is a contractual agreement among some of the largest LMO developers. 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.[103] 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 assure that the Compact Member is not subject to multiple recovery for the same incident of damage both under 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.[104] 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 for example self-insurance, commercial insurance, banker's draft or other form of financial security. Members are also required to seek to encourage the development of commercial insurance for Response obligations.[105] The literature mentions that the reluctance of the insurance industry to provide cover for LMO-related harm to biodiversity was one of the reasons for the biotechnology industry to establish the Compact.[106]The Compact itself however does not resolve the lack of availability of insurance and acknowledges that "*The Members believe that as long as commercial insurance or financial support for potential obligations of SMEs, and public or private research entities to respond is not available or affordable, the Compact's membership goals will be difficult or impossible to achieve."*[107]

[100] 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 Grossmann & Faure 2016.
[101] Faure & Partain 2017, 177.
[102] Grossmann & Faure 2016, 67.
[103] The Compact: A Contractual Mechanism for Response in the Event of Damage to Biological Diversity Caused by the Release of a Living Modified Organism. Second amended text 18 September 2012. The full text is available at: http://www.biodiversitycompact.org/wp-content/uploads/Compact-Second-Amended-Text-with-translation-reference-January-2014-2.pdf(last accessed on April 21, 2021).
[104] See further Carrato, Barkett & Goldberg 2014; Nijar 2013, 284-285 and Telesetsky 2011.
[105] Article 3.5 of the Compact.
[106] See further Beyerlin & Marauhn 2011, available at https://research.vu.nl/ws/portalfiles/portal/813537/-Yearbook+of+International+Environmental+Law-2011-Etty-318-32.pdf (last accessed on September 17, 2020), 318-332; Xiang 2012, 581-600; Bled 2009, 49.
[107] Article 5.4 of the Compact.

The Compact itself does not seem to entail any element of risk-sharing as 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 pro rata basis. The Compact is thus not a risk-sharing agreement but rather a commitment of each member that it will respond to damages caused to biodiversity by the LMOs it developed.

3.4.4 Analysis

Risk-sharing between operators is a valuable financial security instrument as it can on the one hand provide incentives for prevention (through the mutual monitoring among the operators participating in the risk-sharing arrangement) and, on the other hand, it can provide compensation for LMO-related losses. Risk-sharing can, moreover, 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 (like LMOs), operators themselves may have better information (compared to insurers) on optimal preventive technologies, which they can reflect in a 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 has to be fixed. *Ex ante* only information is needed on 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.[108]

There are also particular limits of risk-sharing:

- Risk-sharing can only emerge when there is 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 (for the damage to which operators may be exposed) and for third party liability (as the case of the P&I Clubs for oil pollution). As risk-sharing agreements are based on a collective risk-sharing, there is a strong incentive towards mutual monitoring, thus potentially excluding or at least seriously reducing 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 much better reducing moral hazard 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.

[108] See further on these advantages, Faure & Partain 2017, 172.

3.4.5 Role of government

While risk-sharing agreements are usually the result of private initiative, governments can still play a role in facilitating the establishment of such agreements. Governments can require certain operators to provide financial security[109] which may trigger the creation of a risk-sharing agreement among these operators. An important condition for risk-sharing is that members are able to monitor other members[110] - this can be facilitated through the creation of safety standards. Accordingly, governments can also facilitate risk-sharing arrangements by setting such safety standards,[111] although 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 at a large scale, but this is to an important extent due to the fact that (central and local) governments have initiated the creation of risk pools and have in some cases also subsidized them.[112]

3.5 Fund

3.5.1 Description

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

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 harm suffered by the victim. There may be different rationales for creating a compensation fund. In some cases, funds are established to compensate when no liable injurer can be identified (for example 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.

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

[109] See further 3.7.
[110] Liu & Faure 2018, 271.
[111] See also section 3.2.5.
[112] Jiang & Faure 2020.

Box 6: Compensation fund or *ad hoc* payments?

Different from a permanent fund (whereby 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 which 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 tax payers), whereas compensation funds can be financed by the operators who created the risk (for example 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 case of natural hazards, where no liable party can be identified.[113]

3.5.2 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 fund would be 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, ideally, the financing of the fund should be organized in such a way that those who contributed to the risk also finance the compensation fund. If a tax would be used to finance the fund, it should (to the extent possible) be a tax levy on activities related to the risk.[114] 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. Precisely 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 harm of the victim, but providing amounts that may inevitably not fully correspond with the victim's harm.

Several important features emerge from the literature that has suggested a compensation fund for LMO-related damage. The first 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.[115] A second feature concerns the relationship between the compensation fund and other financial security mechanisms like insurance. A compensation fund usually has a subsidiary

[113] Faure 2007, 353-354.
[114] Faure & Hartlief 1996.
[115] Jungcurt & Schabus 2010, 205.

character, providing an additional layer on top of the primary compensation provided by the liable operators (and his insurer) to the extent that insurance cover would be available. The other possibility is that the compensation fund serves rather as an alternative to insurance solutions, where insurance has not yet emerged for example.[116]

An interesting example of the multi-layered structure of compensation provided via a compensation fund can be found in the US Price-Anderson Act related to compensation for damage caused by nuclear accidents (see box ~~5~~7).

Box 7: The US Price-Anderson Act

In the United States nuclear liability is governed by the Price-Anderson Act of 1957, which has been amended approximately every decade. Each nuclear power plant operator is individually liable for a first tier of $ 375 million. In addition, there is a second layer financed through a retrospective premium scheme. Those premiums are paid only after a nuclear accident has materialized.

When the damage is in excess of $ 375 million, all nuclear operators in the US are obliged to pay the retrospective premium up to $ 121,255 million. This arrangement amounts to a mandatory, statutory risk-sharing agreement. The compensation is paid through the Nuclear Regulatory Commission (NRC) and operators need to guarantee their solvency to pay the retrospective premium through a surety bond, letter of credit, maintenance of escrow deposits, annual certified financial statement or other type of guarantee approved by the NRC.[117] In this model, high amounts of compensation are provided via mandatory risk-pooling by operators (in the second layer), but payments are only due when the nuclear accident materializes.

3.5.3 Practice

According to insurers (in Europe), there is no evidence of the existence of an all-compassing comprehensive fund for LMO-related damage having been established anywhere in Europe.[118] That 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 are, however, GMO-funds that supplement the traditional liability system and usually indemnify only traditional farmers.[119] A special fund solution has been developed in the Netherlands where all stakeholders agreed through a covenant to provide compensation to all who suffer losses resulting from adventitious presence of GMOs in non-GM crops. All stakeholders and, initially the State, have contributed to this fund.[120] 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 *inter alia* mandatory distances between GM and non-GM crops. Farmers following these strict

[116] Ebert & Lahnstein 2008, 579, No. 9.
[117] Faure & Vanden Borre 2008.
[118] Ebert & Lahnstein 2008, 579, No. 9. The conclusion that no such fund has been established is only drawn by the authors for the European context.
[119] Ibidem.
[120] CBD Secretariat 2007, 3 (referring to a report by Munich Re).

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. However, the model was still to be developed further and also included State intervention.[121] The importance of this example is that it shows that financial security can, under particular conditions, support GM production and work as a confidence builder through the guaranteed compensation to non-GM farmers.[122]

The Walloon Region in Belgium has extended the scope of an already existing fund to cover also losses from the adventitious presence of GM-plants in conventional or organic crops.[123] Denmark also introduced legislation on a compensation fund for losses arising from GMO admixture. It is financed by GM-crop growers who pay a particular amount per hectare of GM cultivation into a fund administered by the Danish Plant Directorate (a division of the Ministry of Agriculture).[124] A compensation fund was equally created in Portugal, financed through a green tax on seeds.[125]

Compensation funds also exist for other types of environmental harm. For the compensation of nuclear harm, two separate international compensation regimes were established in the 1960s, and both were substantially revised after the Chernobyl accident of 1986. The funds have been established under the nuclear conventions[126] and are built on a multi-layered compensation scheme whereby liability is channeled to the operator of the nuclear power plant and the operator is liable up to an amount of the financial cap (57 million euro). Up to that amount, the operator needs to show financial security. In addition, two further layers of compensation are added via public funds. A second tier of compensation is paid out of public funds to be made available by the contracting party in whose territory the nuclear installation of the liable operator is situated (193,7 million euro); a third tier of compensation is paid out of public funds to be 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 (142,4 million euro). This third tier applies to damage that goes beyond the amount provided in the second tier.[127] [128]

[121] Koch 2008, 633-634.

[122] See further https://www.nvwa.nl/binaries/nvwa/documenten/nvwa/organisatie/convenanten/-publicaties/coexistentie-convenant-primaire-sector/Co%C3%ABxistentie+convenant+primaire+sector.pdf.

[123] Koch 2008, 629.

[124] Koch 2008, 630.

[125] Koch 2008, 631.

[126] It consists of the convention on third party liability in the field of nuclear energy of July 29, 1960 (Paris Convention) and the Supplementary Convention to the Paris Convention on third party liability in the field of nuclear energy of January 31, 1963 (Brussels Supplementary Convention). A second regime was developed under the AEGIS of the International Atomic Energy Agency (IAEA).

[127] 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. See further on this regime, Liu 2013, 214 and Sands & Peel 2012, 740.

[128] These amounts will be increased once the adapted conventions enacted after the Chernobyl accident will have entered into force. The compensation regime for nuclear accidents has also been studied during the negotiations preceding the NKLSP (See *inter alia* CBD Secretariat 2001, 4-7 and see CBD Secretariat 2006, 2-3).

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).[129] The basis for that liability is to be found in the International Convention on Civil Liability for Oil Pollution Damage (CLC). Under that Convention, there is a limited liability of the tanker owner. 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.[130] 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 Fund Convention.[131] Those Conventions have been adapted many times, but the basic principles remain the same.[132] Finally, in 2003, a supplementary fund was created to provide a layer of compensation in addition to the capped liability of the tanker owner and the compensation provided through the 1971 Fund Convention. This supplementary fund is equally 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, since it is not the state that finances the second layer, but rather oil receivers ensuring a financial contribution from a wider range of operators.[133]

3.5.4 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. 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.[134] 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.[135] The case of compensation for the 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

[129] These guarantees are usually provided via insurance offered by the Protection and Indemnity Clubs (P&I Clubs), a risk-sharing agreement discussed in 3.4.

[130] The oil receivers can be the commercial entities importing the oil or states (if it is the state that receives the oil). See Faure & Wang 2006, 213.

[131] See on the historical development Wang 2011, 60-75.

[132] The adaptations took place in order to adapt the amounts of compensation to new evidence concerning the damage resulting from oil pollution incidents. See Liu, Faure & Wang 2014, 136-145.

[133] For a comparative analysis of both regimes, see Faure 2016, 153-155. Also the international regime for compensating oil pollution damage has been discussed at large in the documents preceding the NKLSP (See CBD Secretariat 2001, 7-9; CBD Secretariat 2006, 4-5 and CBD Secretariat 2009, 10-12).

[134] Koch 2008, 621, No. 141.

[135] Koch 2008, 620, No. 137.

the compensation to states' budgets, thus allowing insufficient preventive effects.[136] 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).[137] Still, even with the IOPC Fund, contributions are not related to risk, but only to the amount of oil received, making risk differentiation imperfect.[138] This underscores the difficulty in creating a regime of risk differentiation (providing incentives of prevention) with a compensation fund.

Box 8: GCCF: *ad hoc* compensation via a private fund

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 harm. 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 mostly of a limited duration).

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. In a period of one and a half years, the GCCF was able to process over 1 million claims, paying more than $ 6,2 billion 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.[139]

Summary of key points:

- 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);[140] it is possible that the individual polluter cannot be identified or that he is insolvent.
- The fund could also intervene in cases where the damage exceeds the financial cap of the liable operator or the amounts covered by insurance.[141]
- A compensation fund may also have procedural advantages by adjusting the administration of the fund to specific needs, thus reducing the barriers for claimants.[142]
- A 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 other layers constituting of payments made by a liable operator and the financial security provider.

[136] See Heldt 2015 and Vanden Borre 2007.
[137] For a comparison of the two regimes see Faure 2016, 150-155.
[138] Faure & Wang 2006, 213-214.
[139] See further Feinberg 2012, 125-183 and Faure & Weber 2015, 9-12.
[140] Although in that case often *ad hoc* compensation is arranged. See box 6.
[141] CBD Secretariat 2006, 8.
[142] Koch 2008, 620, No. 136.

- Provided that the fund is able to collect sufficient funds, it can have the capacity to compensate the harm. If there are unknown or hard to predict risks, actual claims on the fund may exceed expectations.[143]
- Compensation funds have as a main disadvantage that the financing is usually not risk-related, thus providing insufficient incentives for prevention.[144]

3.5.5 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). The 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 which finances the compensation fund (at least not entirely) with tax payers' money.

3.6 Other financial security mechanisms

As was indicated above,[145] this study focuses on four financial security mechanisms considered most relevant in the context of Article 10 of the NKLSP. As set out in section 3.1, 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 for which they are considered less relevant and therefore not further considered in this study.

Bonds

Bonding is an instrument allowing financial risks to be covered on the capital market. 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 favour of the operator of their choice. If during the period of the bond (say one year) no accident happened, the amount of the guarantee provided by the bond would be paid with interest. If the risk materialized, the bond posted would be used to cover the damage.[146] Bonding has been discussed *inter alia* in connection to carbon capture and storage, among other areas.[147] 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 be a suitable instrument to cover the type of biodiversity damage envisaged by the NKLSP.

Bank guarantees and deposits

A guarantee comes down to a private party (for example a bank) providing a financial guarantee that it will meet the obligations of an operator. The idea thereby is that the financial institution (bank)

[143] Koch argues that this may be a risk in case of LMO-related harm, Koch 2008, 620-621.
[144] Koch 2008, 621, No. 141.
[145] See 3.1.
[146] See further on catastrophe bonds, Tyran & Zweifel 1993.
[147] Faure & Partain 2017, 179-182.

guarantees that 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 those bank guarantees are rarely found in practice for environmental liabilities is that the cost of those guarantees can be prohibitively high.[148] As bank guarantees are considered relatively expensive (especially when compared to insurance) they do not seem to be an attractive financial security instrument either.

Government compensation

An alternative also mentioned in the literature with respect to LMO-related losses is that the government would simply pay the compensation if the risk materializes.[149] In theory, the government could in a specific case always decide to provide *ad hoc* compensation (see box 46). There is not necessarily a specific regulatory framework needed for the government to decide *ad hoc* to compensate. The major disadvantage is that when the government pays, no adequate incentives for prevention of risks are provided to operators.[150] One scholar therefore considered *ad hoc* compensation (for natural disasters generally) a "catastrophic response to catastrophic risk".[151]

Box 9: *Ad hoc* contractual solutions

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 a distance of 100 meters of GM maize fields, irrespective of potential admixture. The GM farmers participating in the project had to contractually commit themselves to adhere to the farming standards established by seed producers. The project was launched in 2005, but discontinued in 2007.[152] In this contractual example, the producer took over the risk from GM farmers, but it is not a risk-sharing agreement.

3.7 Conclusion

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

As can be seen from the information on practical experience with these mechanisms, there are often no walls between the various mechanisms. In practice, a variety of instruments may emerge, whereby 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 zones between different mechanisms as a result of which they could rather be qualified as hybrids. Indeed, many of the examples described above combine features of different

[148] Faure & Partain 2017,178. 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.
[149] Paull 2019.
[150] Dari-Mattiacci & Faure 2015.
[151] Epstein 1996.
[152] Ebert & Lahnstein 2008, 580, No. 10; Koch 2008, 634, No. 194. The literature does not mention the reason why the project was discontinued.

financial security mechanisms, including the fund created in the Netherlands to cover damage from adventitious presence of LMOs described in section 3.5.3 and the arrangements established under the nuclear conventions described in section 3.5.3.

The analysis showed that each of the mechanisms discussed has 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 harm. These so-called smart mixes of mechanisms[153] could consist of mechanisms created at different levels of governance (national or international initiatives) involving both public and private initiatives. An example would be private governance via risk-pooling or self-insurance, domestic legislation mandating the purchase of liability insurance and an intergovernmental instrument creating a compensation fund.

An example of a multilayered compensation scheme is a system developed in the Netherlands for terrorism-related risks, an area with high uncertainty (as set out in box ~~8~~10).

Box 10: Compensating terrorism-related risks

After the "9/11 attacks", insurance companies sought to exempt damage related to terrorism from their coverage. Following that initial reaction, negotiations took place between (re)insurers and governments as a result of which, in many jurisdictions, pool constructions emerged, usually consisting 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. The Dutch terrorism reinsurance pool provides an interesting example. It was originally constituted as follows:

Insurers: € 400 million
Reinsurers: € 300 million
Dutch government: € 300 million
Total: € 1 billion

The Dutch government intervenes in this market by facilitating the provision of insurance but demands a premium for its reinsurance capacity. 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, in a second stage the governmental coverage could be reduced to € 50 million since (re)insurers increased their contribution.[154]

A mix of different mechanisms could also be employed to cover LMO-related harm. Some authors have proposed a model of a multilayered system whereby 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.[155] In this proposal, the compensation scheme would be a supplementary scheme

[153] See further Van Erp et al. 2019.
[154] Bruggeman 2010, 378-379.
[155] It is the system *inter alia* proposed by Jungcurt & Schabus 2010, 205.

(on top of the capped operators' liability covered by financial security) and could consist either of an intergovernmental scheme or risk-pooling by industry.

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 policy-makers were to limit financial security to mandatory insurance, for example, 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 harm occurs (see box 119).

Box 11: Carbon capture and storage: An example of a flexible approach

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. This provides information to the licensing authorities on the type of financial security that can be accepted when offered by operators. The approach has the advantage of allowing sufficient flexibility and avoiding unnecessary costs (for example forcing major operators to transfer risks to an insurance company). The model requires financial security but leaves flexibility to 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 followed in the US EPA Guidance Document on underground injection control financial responsibility guidance: 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.[156]

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.[157] Mandatory financial security also exists for many other environmental risks and more particularly also for the oil pollution and nuclear risks as set out in section 3.5.2 (box 57) and 3.3.3 (box 12) and 3.5.3 above and is prescribed in a number of other international treaties including the 1952 Rome Convention for damage caused by aircrafts to third parties on the surface; the Montreal Convention for the unification of certain rules for international carriage by air; the Convention on liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea; and the 2003 Protocol on civil liability and compensation for damage caused by the transboundary effects of industrial accidents on transboundary waters.[158] Obtaining financial security has been made mandatory in all of the mentioned international conventions.

[156] Faure & Partain 2017, 189.
[157] Discussed in 3.5.3.
[158] See for a detailed description, Faure, Liu & Philipsen 2015, 11-55, with a summarizing table on p. 52.

4. Assessment of impacts

4.1 Introduction

This section will, as prescribed by Article 10(3) 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 particularly be paid to the impacts of the different mechanisms on the stakeholders in 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 would be considered under international trade law would depend on the specific measures taken by a country.

4.2 Approach

Given the limited availability of financial security mechanisms today for damage related to LMOs, this study will assess the impacts of the four main financial security mechanisms described in section 3 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 Calabresi on the costs of accidents.[159] Calabresi argues that the goal of liability law should be to minimize the total costs of accidents. 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 (referring to the need that those with the best capacity to carry the loss, for example because they are insured, should cover the loss). Finally, Calabresi also identifies the administrative or transaction costs of administering the liability regime (for example, costs of lawyers, court fees etc.). Calabresi distinguishes between these costs as follows:

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

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

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 relate more to Calabresi's secondary costs, the effective loss-spreading. 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 (for example given the available financial assets) be better able to carry the

[159] Calabresi 1970.

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 born 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 harm. 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) NKLSP.

4.3 (Re)insurance

4.3.1 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,[160] when parties are bound via the price mechanism, an increase of costs (such as an insurance premium) will (to the extent that the market allows this) be passed on by the operator in the final price.[161] 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 using LMOs[162] but whether this passing on of the cost through the price mechanism is of substantial importance (especially compared to non-GM products) is at this moment hard to judge. As explained above, LMOs are still largely excluded from insurance policies and there is even less experience with insurances covering LMO-related damage to biodiversity, meaning it is difficult to know how heavy a burden the insurance premium would be. A study by Bock et al.[163] calculated for rapeseed production the extra costs for changing agricultural practices. The analysis includes both the costs of monitoring GMO content, additional costs related to prevention as well as insurance costs. They came to a price of 345 € per ton for organic oil seed production compared to a cost of 126 € for conventional seed production.[164]

[160] Coase 1960.

[161] In the words of Koch: "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" (Koch 2008, 617, No. 123).

[162] See also Telesetsky 2011.

[163] Bock et al. 2002.

[164] Bock et al. 2002, classified oilseed rape into three categories, namely conventional certified seed production (Farm 1), Organic certified seed production (Farm 2), and conventional production with farm-saved seeds (Farm 3). Total costs ranged from 126 €/t for Farm 3 and 127 €/t for Farm 1, to 345 €/t for Farm 2. For Farm 1 the main part

Theoretically, all kinds of scenarios are possible. If insurance costs were 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. According to the literature, concerns regarding the higher prices that could result from insurance premiums to be paid was an important reason not to impose mandatory financial security under the NKLSP.[165]

Another aspect of the economic costs relates to the costs of the functioning of insurance. Indeed, insurance premiums are always higher than the objective value of the risk. It at least includes the administrative costs for the functioning of insurance. These administrative costs will be higher for insurance than when internal reserves are used in case of self-insurance, but could be lower than with a compensation fund.[166]

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.

4.3.2 Social

The advantage of insurance, especially first party insurance, is that it can provide cover exactly corresponding to the risk attitude (and therefore demand of financial security) of the insured. From a social perspective, however, a disadvantage of a first party system is that it implies that a potential victim pays the premium for its own potential losses. In a context 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 harm.[167] Also, 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 LMO.[168] 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 whereby, for example, certain operators in the supply chain would take out

of the costs comes from monitoring of the GMO content, while the costs for changes of agricultural practices are estimated to be zero (adding an extra spring crop to the rotation). Monitoring costs are very high for both Farm 1 and Farm 2 because yields and the area of the oilseed rape producing fields are small. Both farms are selling a high added value product and thus also the indicative insurance cost is high, especially for the production of organic certified seeds. For more information, see Bock et al. 2002, 112-113.

[165] There was a fear that financial security might result in higher prices for genetically modified crops and animals (Telesetsky 2011).

[166] So Faure & Hartlief 1996.

[167] Paull 2019, 31-46; Swinbourn 2019, 32.

[168] See Dan Flynn, AC21 Wants USDA to Investigate Crop Insurance for Genetic Harm To Organic Crops, November 21, 2012, Food Safety News, available at https://www.foodsafetynews.com/2012/11/ac21-wants-usda-to-investigate-crop-insurance-for-genetic-harm-to-organic-crops/ (last accessed on 07 October, 2020).

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-size operators. It is for that reason that it was argued above[169] that if mandatory financial security were to 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 premium to deal with insurer ambiguity. This would especially be problematic for small- and medium-size operators and could put them at a disadvantage to larger operators, especially if insurance were to be mandatory.[170]

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 harm also applies to the developing country context. In addition, issues related to monitoring, governance and enforcement of insurance mechanisms may be particularly challenging.

4.3.3 Environment

The incentives for prevention (thus reducing Calabresi's primary costs) 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). A 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 small 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.

4.4 Self-insurance

4.4.1 Economic

As detailed above, self-insurance consists of (usually larger) operators making their internal reserves available as financial security. Administrative costs for self-insurance are low and arise primarily at the moment when damage occurs and compensation needs to be paid and to some extent when setting up the arrangements for the self-insurance. In addition, self-insurance, as opposed to regular insurance,

[169] See Box 11.
[170] Nijar 2013, 284.

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.[171] This requires some level of external control and monitoring, leading to some expenses.

In order to make self-insurance work, operators would have to set aside particular reserves or assets that would only be used in case of liability for LMO-related damage (to biodiversity). To avoid disinvestments, self-insurance usually only requires 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 to be used for larger players in the supply chain. The economic impact would generally only be felt in case of damage, 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.

4.4.2 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-size 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 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 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, which also is a negative social impact.

[171] Along the way that this happens within OPOL, discussed above in Box 2.

4.4.3 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 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 option of all financial securities as no protection is provided from claims of creditors.[172] 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.

4.5 Risk-pooling

4.5.1 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*. That means that if the risk does not 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.[173] 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 so 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 be hardly 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.

4.5.2 Social

The homogeneity of the pool and the sharing of risks creates 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

[172] See implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, Guidance Document 4, 27 which mentions "Certainty also depends on stringency of required financial tests".

[173] Recall from the example of the oil pollution (3.4.3) 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 (3.5.3).

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, for example, could potentially be split into different pools for, respectively, small- and medium-size farmers. The pools could subsequently differentiate for example 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 in the risk-pool via 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 losses that occur to the community.[174] 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 hazard and free-riding. However, whereas those risk-pools might have emerged in developing countries, for example to cover agricultural losses, it is highly unlikely that the same would cover LMO-related harm to biodiversity given the unpredictability of the scale of the damage.

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

4.5.3 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. Of importance is more particularly whether there is sufficient cover, whether it is possible to call directly on the funds available via the risk-pooling scheme and if the cover provided is formulated in such a way as to cover restoration of biodiversity. The example of the P&I Clubs that have wide experience in covering for oil pollution damage shows that it is possible to use a risk-pooling scheme to restore some types of damages to the environment.

[174] Risk-sharing among farmers for example emerged in Burkina Faso (Sommerfeld et al. 2002) and in Ethiopia (Berg et al. 2020; Dercon et al. 2014) and in Tamil Nadu in India, local mutual pools to protect farmers via risk-sharing have been created (Kingma 2007).

4.6 Fund

4.6.1 Economic

A fund can be financed in various ways. If the fund would be paid via the general taxes, the fund would not generate any preventive effect. If the fund would be financed through contributions paid by operators, there may be some possibility to relate 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.[175]

4.6.2 Social

A fund is usually financed by operators creating the 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 risks 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 risks. 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 whereby for example importers of LMOs or the end users of the LMOs would pay contributions to cover for future losses. In this respect, insufficient human resources, the costs of the operation of the fund, the number of paying operators and the amount of payments required, might add to the complexities of establishing an effective compensation fund. Theoretically one could even imagine a global fund (created through an intergovernmental instrument). Depending on who would pay the contributions to the fund and who could potentially benefit this could be more or less socially equitable.

4.6.3 Environment

The environmental effects of a fund very much depend on whether the fund applies an effective mechanism of risk differentiation which is needed to create incentives for prevention. If the fund were to be financed via the general taxes, there would be no preventive effect. If it were to be financed by operators (for example with a levy on the quantity of LMOs produced), there may be some effect, although usually the fund (different from insurance) 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 harm. There are many examples of environmental funds at both the domestic level[176] and the international level[177] which both provide compensation for the costs of restoring environmental harm.

[175] Faure & Hartlief 1996.
[176] Such as the Superfund in the US.
[177] Such as the IOPC Fund discussed above (3.5.3).

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.

5. Conclusion

This study described a selection of financial security mechanisms, their modalities of operation, the entities that can provide financial security in relation to their suitability to cover the type of damage covered under the NKLSP. The study showed that in practice many hybrid mechanisms have been developed, combining elements of more than one financial security mechanism. It also provided examples of multi-layered financial security mechanisms that provide compensation by combining multiple financial security mechanisms, each supplementing the other.

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 high uncertainty, not only with respect to the probability of an incident, but also with respect to the potential scope of the damage. That explains why currently there is no financial security mechanism available to cover the type of biodiversity damage covered by the NKLSP.

A second consequence is that whereas 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. As biodiversity cannot generally be attributed to an individual, a third party financial security mechanism could be more suitable for damage to biodiversity. Third party financial security has the advantage that the liable operator will pay for the financial security to cover losses. 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 (like 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 that therefore no financial security is provided. To mitigate this risk, guarantees are required that ensure that, in the case of damage, compensation is available even in 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 can provide incentives for prevention. These incentives are generally stronger in mechanisms that require *ex post* contributions given that only in case of damage participants are required to fund the mechanism. Self-insurance, but also risk-pooling would for example provide strong incentives for prevention. Prevention incentives can 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 would become insolvent as a result of the damage. This is regarded a risk of especially 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 of activities. Monitoring can provide another environmental benefit of financial security mechanisms. Where some mechanisms rely on external monitoring (for example in the case of insurance or funds, where an insurer monitors the activities of the insured), other mechanisms rely on mutual monitoring of 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 social impacts of financial security mechanisms, the study pointed to the distributional effect of the various mechanisms. In 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 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 the type of insured to which the insurance is provided. 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 which may ease of access, 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 complex, lengthy and costly process. Direct access for claimants to insurers could mitigate this issue.

Finally, this study 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 the type of risk (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 (for example larger operators in the supply chain) who might be willing to provide financial security either via self-insurance or via a risk-sharing agreement.

In that respect governments could play a facilitative role to promote financial security, including by creating the enabling conditions for the development of a variety of financial security mechanisms.

The study showed that in a number of developing countries, experience with financial security mechanisms exist, 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 to develop 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 that would also benefit developing countries.

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Annex 1: Examples of exclusions of LMO-related risks by various insurers

Insurer & insurance type	Clauses excluding GMO damage in the insurance policies
DUAL Australia Public Liability Wording (11/13), DUAL Australia iTech Information Technology Wording (12/09), 2016	Section 5: Exclusions WE will not cover the INSURED, including for compensation, Defence costs or other costs, expenses or loss, in respect of: 5.14 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.[178][179]
Winter Crop Insurance Product Disclosure Statement, Achmea Australia, 2017	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: 16. 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 financial and/or economic claims, environmental impairment, ecological damage, or damage to biodiversity.[180]
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

[178] DUAL Australia Public Liability Wording (11/13), BizCover, available at https://www.bizcover.com.au/wp-content/uploads/2014/07DUAL%20Public%20Liability%20Wording.pdf (last accessed on 02 October, 2020).
[179] DUAL Australia iTech Information Technology Wording (12/09), available at https://www.centrewest.com.au/wp-content/uploads/2016/07/IT-Wording-12-09.pdf (last accessed on 02 October, 2020).
[180] Winter Crop Insurance Product Disclosure Statement, Achmea Australia, June 2017, Version C 4.0, available at https://www.achmea.com.au/wp-content/uploads/2017/07/Achmea_Australia_Winter_Crop_PDS_2017.pdf (last accessed on 02 October, 2020).

	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.[181]
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. 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.[182]
L&T General Insurance Company	General exclusions: the company shall not provide indemnity in respect of,

[181] ICICI Lombard General Insurance Company limited, product liability insurance, the policy is available at https://www.idfcfirstbank.com/content/dam/IDFCFirstBank/form-center/business-insurance/Policy-Draft-PDT-LIABILITY.pdf (last accessed on 07 October, 2020).

[182] PT Asuransi AXA Indonesia Redefining insurance, Smart Traveler, the policy is available at https://axa.co.id/wp-content/uploads/axagi/download_center/file/Policy_Wording_SmartTraveller-bilingual-update-merged.pdf (last accessed on 07 October, 2020).

Limited, commercial general liability insurance policy, 2010	... 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. [183]
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.[184]
LocalTapiol, 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).[185]

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[183] L&T General Insurance Company Limited, commercial general liability insurance policy, 2010, the policy is available at https://www.irdai.gov.in/ADMINCMS/cms/Uploadedfiles/21_CGL%20-%20Policy%20Wordings.pdf (last accessed on 07 October, 2020).

[184] Sun General Insurance, Machinery insurance policy Grenada, 2013, the policy is available at https://www.sungeneral.net/images/policies/machinery-breakdown/SPECIMEN-Grenada-Machinery-Insurance.pdf (last accessed on 07 October, 2020).

[185] LocalTapiol, liability insurance VY1, 2014, the policy is available at https://www.kokairport.fi/files/6 (last accessed on 07 October, 2020).