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A Smart Mix of Remedies to Strengthen the Polluter Pays Principle in the EU

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A Smart Mix of Remedies to Strengthen the Polluter Pays Principle in the EU

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Abstract

What remedies should be imposed by courts for environmental harm? This is certainly not an easy question to answer because, first of all, there are many different types of harm to the environment. In some cases a remedy might not be that difficult to develop; in others it may be extremely complex. The traditional remedy in tort law was to impose damages; in other words: a duty imposed on the polluter to provide monetary compensation equal to the harm that had been caused. For a variety of reasons there is, however, a tendency in the law to move away from the imposition of damages and to impose restoration of the damaged environment as the primary remedy. Against the background of these evolutions, our central research question is: what are efficient remedies for environmental harm? For reasons of simplicity we limit our analysis to comparing monetary compensation (damages) with restoration (or restoration-based compensation). Thereby, we also do not distinguish the various practical settings in which restoration can arise. The methodology we use to answer this question is the economic approach to law. The reason is that law and economics has stressed the importance of exposing potential polluters to the costs of their harmful activities. We will therefore use the economic approach to analyse how various remedies could be structured, also in combination and what the trade-off (advantages and disadvantages) of both remedies are. This economic approach might provide a model to analyse how remedies in specific cases of environmental harm should be structured in legislation and case law. The case we discuss will show that there are particular inefficiencies that arise in the current remedies, as a result of which the economic approach may support an efficient design of remedies for environmental harm.

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1. INTRODUCTION

What remedies should be imposed by courts for environmental harm? This is certainly not an easy question to answer because, first of all, there are many different types of harm to the environment. In some cases a remedy might not be that difficult to develop (for example when waste has been illegally dumped and has not yet caused further harm than being in the wrong place); in others it may be extremely complex (for example when damage has been caused to the biodiversity in a nature reserve). The traditional remedy in tort law was to impose damages; in other words: a duty imposed on the polluter to provide monetary compensation equal to the harm that had been caused. For a variety of reasons there is, however, a tendency in the law to move away from the (mere) imposition of damages and to impose restoration of the damaged environment as the primary remedy. There are various reasons for this development, one being that environmental harm is often difficult to calculate as a result of which the judiciary is increasingly reluctant to provide monetary compensation for environmental harm; another reason is that monetary compensation paid by the polluter

does not necessarily make the society better off. Those are some of the explanations why increasingly restoration is used as an important (in some cases primary) remedy in cases of environmental harm, both in legislation as well as in case law. However, also restoration as a remedy for environmental harm has problems of its own. One problem is that it is not always clear what is cost-effective restoration (the costs of restoration may be higher than the long-term environmental benefits) and it is not clear whether a duty to restore fully exposes the polluter to the social costs caused by the polluting activity. If a polluter were only held to restore the damaged environment, that may not deal with all damage caused by the polluting act due to interim and permanent losses. Moreover: whereas calculating the amount of environmental harm (in case of a monetary reward) poses problems of information and uncertainty for the judiciary, restoration may have similar problems, as it may be difficult for the judiciary to determine cost-effective restoration. Moreover, enforcement may be more complicated as a longer term follow-up may be needed to verify compliance with the duty to restore. In addition, there are problems common to both remedies, more particularly the insolvency risk.

Against the background of these evolutions, our central research question is: what are efficient remedies for environmental harm? For reasons of simplicity we limit our analysis to comparing monetary compensation (damages) with restoration (or restoration-based compensation).[1] Thereby, we also do not distinguish the various practical settings in which restoration can arise. The methodology we use to answer this question is the economic approach to law. The reason is that law and economics has stressed the importance of exposing potential polluters to the costs of their harmful activities. Law and economics has warned that if that would not be the case, it might result in an underdeterrence of the polluter. We will therefore use the economic approach to analyse how various remedies could be structured, also in combination and what the trade-off (advantages and disadvantages) of both remedies are. This economic approach might provide a model to analyse how remedies in specific cases of environmental harm should be structured in legislation and case law. The case we discuss will show that there are particular inefficiencies that arise in the current remedies, as a result of which the economic approach may support an efficient design of remedies for environmental harm.

After this introduction, we first sketch the goals of the various remedies in environmental law (2); we then discuss the trade-off of restoration versus damages in more detail, focusing on both remedies and equally discussing several common problems (3); This leads us to a summary sketching an optimal order and combination of remedies (4). We then present one case that in our opinion illustrates problems with the current remedies for environmental harm (5). Section 6 concludes.

2. THE GOALS OF REMEDIES IN ENVIRONMENTAL LAW

From an economic perspective, the goal of remedies in environmental law is relatively simple: the potential polluter should be exposed to the full social costs of its activity.[2] This implies on the one hand that the costs of prevention should be borne by the potential polluter,

[1] The term 'restoration-based compensation' is used by C.A. Jones and L. DiPinto, 'The Role of Ecosystem Services in USA Natural Resource Liability Litigation', 29 *Ecological Services* 333 (2018).

[2] Excluding the environmental costs of accidents caused by late emergency responses and the environmental impacts of intense clean-up when caused by insurers or public administrations..

but equally the expected damage.[3] The principle is simple, but working this out in practice, especially exposing the polluter to the expected harm is in practice often more complicated.

Pure environmental losses are peculiar because they are dynamic. Pollution is notoriously a kind of harm with progressive tendency. As time goes by, environmental costs increase because more and more goods and services are affected. For instance, toxic substances leaking down into the soil first affect cultivations, then downstream waters and they may in turn cause human diseases to those drinking water or economic losses to the industry (e.g., a close factory producing bottled water). Likewise, toxic air emitted by a factory first hurts workers, then close economic activities and finally the ecological health of the whole ecosystem together with the human health of local residents. This trend in social costs may be interrupted by activities aimed at stopping the damage and tackling the risk of additional harm (not just at remedying the previous harm). For that, time and knowledge about the existing harm play both a crucial role. It is indeed essential that informed parties (polluters, the public administration entitled to control) are correctly incentivised to take immediate action from the first moment they know about the polluting event.[4] Arguably, the expenses referred to this type of action may be quite high compared to others in case of large accidents.[5] In sum, there may be difficulties in assessing the expected harm. Problems specifically arise when there is a long time lapse between the tort (the wrongful emission giving rise to the damage) and the moment that the remedy is applied.[6] Problems also arise when damage is caused to objects to which private property rights have not been allocated (such as forests, wetlands, aquifers or the marine environment).Those are qualified as ecological losses[7] and are particularly difficult in determining.

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[3] This obviously corresponds to Calabresi's famous framework developed in 1970. See G. Calabresi, *The Costs of Accidents: A Legal and Economic Analysis* (1970).

[4] It would be worth distinguishing the information about the harmful event (pollution) from the information about the effects on the environment. While the polluter is the least cost-avoider with regard to the information on the event (he knows immediately about pollution caused by his own activity), the information about the effects on the ecosystem might be too technical. If the pollution is going to harm an ecosystem with unique characteristics in terms of biodiversity or a complex ecosystem that has no close substitute and for which it would be not feasible to do an accurate compensatory restoration, it is very likely that the polluter will ignore this technical information related to data owned by environmental agencies or other private organizations (national or international). Would, for instance, a polluter be aware of the fact that wetlands provide vital ecosystem services to the whole globe and they cannot be replaced easily by equivalent substitutes? Likewise for coastal estuaries and so on. Unless such information is easily available to the polluter beforehand, it cannot be expected that the harm to these kinds of ecosystems will be efficiently prevented by polluters. The same applies to the best practices of clean-up and restoration in light of the specific characteristics of the environment. After distinguishing the two categories of information, it can be argued that environmental agencies and organisations holding data on the specific conditions of ecosystems need to be incentivized to disclose such information and make it available to polluters.

[5] P. Manuelli, 'Assicurazione-Ambiente-Le spese per impedire o diminuire il danno da inquinamento' 1 *Ambiente e Sviluppo* 43 (2000). For instance, the Sandoz accident of 1986 was followed by a very high number of claims for damages ranging around 25 million euros. However, the money needed to stop water contamination and preserve the healthy state of ecosystems represented a separate head of damages.

[6] This is the well-known problem of 'historic pollution'. For instance, the European Environment Agency recently reported around 2,8 million sites as potentially polluted due to industrial activities, waste, mining, leakage from transportation of hydrocarbures and 14% among them are still to be rehabilitated. See: https://www.eea.europa.eu/highlights/soil-contamination-widespread-in-europe

[7] See further J. Liu, *Compensating Ecological Damage: Comparative and Economic Observations* (2013). See also Jones and DiPinto (above) who described the evolution of the US Natural Resource Damage Assessment Law as the pillar for the prevention of harm to public natural resources, given that remedies for harm to private natural resources are already provided by property rights and private liability laws. Moreover, public natural resources

In addition to the economic perspective, from an ecological perspective the remedy should not only aim at exposing the potential polluter to the costs, but should equally aim at restoring the harmed environment.[8] After all, through the environmental tort the ecological equilibrium has been disturbed. The remedy should ideally lead to a restoration of the ecological situation that existed before the harmful act occurred.[9] It may be clear that there might be a potential conflict between the economic and the ecological perspective for the simple reason that reaching restoration may be costly. From an economic perspective restoration would only make sense if the marginal costs of restoration are lower than the marginal benefits in restoring the environment.[10] If that were not the case, the simple logic is that the restorative action would be a socially wasteful activity.

This brief introduction into the goals of remedies already indicates a difference in the economic and ecological approach which may also have its relevance for the choice of remedies: from an economic perspective the importance is to expose the potential polluter to the costs of the harmful activity (whereby there is as such no particular preference for a specific remedy), whereas from an ecological perspective the deterrence (stressed in the economic approach) may not be the primary goal but rather the restoration of the damaged environment. That may, at least from an ecological perspective, imply a preference for restoration.[11]

3. RESTORATION VERSUS DAMAGES

We will now examine the pros and the cons of the two remedies on which we focus our analysis, leading in the next section to a prioritization. The perspective we will take follows from the previous section and is therefore dual: on the one hand we will examine whether the remedy is able to expose the polluter to the total costs of its harmful activity; on the other hand we will ask the question whether the remedy allows for a cost-effective restoration (thus combining the economic and ecological perspective and not aiming for restoration at all costs, i.e. also when marginal costs would be higher than marginal benefits).

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are those with the highest share of non-use values and thus the label of strict environmental damage suggested by Hay and Thébaud would be applicable.

[8] See more extensively on remedies for environmental harm from a legal perspective: M. Wilde*, Civil Liability for Environmental Damage. A Comparative Analysis of Law and Policy in Europe and the US,* chapter 10 'Remedies for Environmental Damage' (2013). And for a reference point on restoration in ecology, see G.D. Gann et al., 'International Principles And Standards For The Practice Of Ecological Restoration', *Restoration Ecology* S1 (2019).

[9] Taking into account that the damaged environment undergoes anyway natural recovery, remedies should ideally find a compromise between natural (slow) recovery and the recovery of the 'use' of the injured environment, at least for vulnerable ecosystems.

[10] This should include marginal benefits for future generations, especially with long-term restoration goals. For a discussion related to the role of discounting and intergenerational equity in the benefit-cost analysis of restoration, see W.D. Shaw and M. Wlodarz, 'Ecosystems, Ecological Restoration, and Economics: Does Habitat or Resource Equivalency Analysis Mean Other Economic Valuation Methods Are Not Needed?', 42(5) *Ambio* 628 (2013).

[11] However, on the convergence between ecological and legal perspective, see V. Fogleman, 'The Duty To Prevent Environmental Damage In The Environmental Liability Directive; A Catalyst For Halting The Deterioration Of Water And Wildlife', 20 ERA Forum 707 (2020).

3.1 RESTORATION

Restoration does have many advantages as it seems at first sight to be able to reach both goals of remedies in environmental law (restoring the environment as well as cost internalization). Restoration seems optimal to reach the goal of restoring the harmed environment. If that can be done in a cost-effective manner, it moreover also complies with economic starting points. 'In kind restoration' can be achieved through an injunction to restore. 'In-kind/resource compensation' is indeed a typical non-monetary remedy in tort law and its aim is to remedy nonpecuniary losses. With special regard to environmental harm, restoration may be defined as the process aimed at compensating an ecosystem for outside influences, so that it "can continue to behave or resume behaving as if these were not present".[12] For this reason, restoration projects initiate or accelerate the recovery of an ecosystem with respect to its health, integrity and sustainability.[13] They may consist of a set of practices, such as erosion control, reforestation, removal of non-native species, reintroduction of native species, revegetation and habitat improvement for targeted species. Restoration has the advantage not only that it can ex post repair harm caused in the past, but it could also aim at the prevention of future harm. Restoration is often also considered easy to apply as it avoids complicated questions of monetizing non-market goods like ecosystems. If the judge has the possibility to order restoration, this can avoid the complicated process of calculating damages in case of environmental harm.

Given the difficulties raised by monetary awards, restoration has gained a primary role as a remedy for environmental harm.[14] Restoration may also be able to expose a polluter to costs and could thus lead to cost internalization. Restoring the harmed environment can be costly and could thus provide ex ante incentives to potential polluters by exposing them to the costs of restoration. The advantage of the instrument is that the polluter needs to be aware of those costs ex ante (thus providing incentives for prevention) whereas the judge ex post should not necessarily know the exact costs, but can suffice by ordering the restoration.

Notwithstanding the many potential advantages of restoration as a remedy, there are important limits as well.

First, restoration may work well in an easy case, i.e. where it is relatively clear what the harm to the environment was and how it can be restored. The typical example is where an operator would have illegally deposited waste in order to save the costs of lawful waste disposal (and the payment of fees). Supposing that the waste can be easily identified and that during the time the time was deposited no further harm is caused to the subsoil or groundwater, a relatively straightforward injunction can force the operator to remove the deposited waste in a lawful manner, thus reaching both the goals of cost internalization and restoration. The problem is, however, that often restoration is not as easy as in this typical example because

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[12] William R. Jordan III was the American botanist who developed the new approach to restoration that considerably influenced the environmentalism in the US and abroad. He was among the founding members of the Society of Ecological Restoration and he is considered to be the current world leader on restoration. The citation comes from T.L. Goedeke and S. Rikoon, 'Otters As Actors: Scientific Controversy, Dynamism Of Networks, And The Implications Of Power In Ecological Restoration', 38(1) *Social Studies of Science* 111, at 111 (2008).

[13] Society for Ecological Restoration (SER) International Science & Policy Working Group 2004.

[14] H. Wendel, 'Restoration As the Economically Efficient Remedy for Damage to Publicly Owned Natural Resources', 91(2) *Columbia Law Review* 430 (1991) and F.B. Cross, 'Natural Resource Damage Valuation', 42(2) *Vanderbilt Law Review* 269 (1989).

data on the provision of ecosystem services are difficult to be interpreted and metrics need to be chosen. For example if a wetland has been polluted by emissions of toxic substances. In those cases it is not clear how a duty to restore could be formulated even if data on the ecosystem services provided are available.[15]

Second, the example also illustrates that in many cases a real restoration of the environment (i.e, all damaged and/or lost ecological services) may simply be impossible for many reasons. There might be at least three scenarios of impossibility.

The first scenario is the technical impossibility, i.e. when data on pollution are not available or there are no tools of measurement, including missing data on the baseline and hereby the target of restoration. The difficulty is often caused by the lack of ecosystem service modeling and/or accounting. The issue occurs both in US and EU law.[16]

The second scenario is the ecological impossibility, i.e. when the recovery of habitats and protected species – biodiversity – is simply impossible or there are species irremediably destroyed. This happens particularly with the environmental harm to biodiversity or to vulnerable natural resources, such as biodiversity hotspots, but also with the long-term (unknown) damages caused by accidents.[17] The idea of biodiversity hotspots became popular in conservation ecology because even if it is well-known that biodiversity is under threat, millions of species, plants, populations and habitats are unknown and unmonitored. In order to overcome the difficulty (impossibility) of assessing and quantifying (in physical terms) biodiversity losses, ecologists proposed to identify 'hotspots' which are homes to an incredible number of endemic species and would need to be conserved. An additional example might be given by buffer zones around protected areas which provide unique and irreplaceable services to the same protected areas. The functions of buffer areas are the object of several studies and projects.[18] Other sites for which restoration would be impossible (also in terms of finding equivalent substitutes) are key terrestrial ecosystems, such as old forests and peatlands, which are now the object of several restoration projects due to the many benefits that they can provide to both human and the environment, key marine ecosystems, such as coral reefs, mangroves and the deep-sea bed, and coastal ecosystems whose function

[15] This draws to the case of complex habitats and ecosystems providing many services for which a substitute is difficult to identify either because it is very complicated to measure all lost services or because it is difficult to measure the benefits of a replacing ecosystem that can provide a quantity, quality and value of services equivalent to the lost ones.

[16] On the state of the art in the EU regarding ecosystem service accounting, see the work of the Joint Research Center: A. La Notte et al., 'Implementing an EU System of Accounting for Ecosystems and their Services. Initial Proposals for the Implementation of Ecosystem Services Accounting' JRC Technical Report (2017); B.B. Maes et al., 'Mapping and Assessing Ecosystem Services in the EU – Lessons Learned from the ESMERALDA Approach to Integration', 3 *One Ecosystem* (2018); S. Vallecillo et al., 'How Ecosystem Services Are Changing: An Accounting Application At The EU Level', 40 *Ecosystem Services* 101044 (2019); J. Maes et al., 'Mapping and Assessment of Ecosystems And Their Services: An EU Ecosystem Assessment', JRC Science for Policy Report, EUR 30161 (2020).

[17] On the unique functions of biodiversity for the society in terms of productivity, resilience and adaptability and, more in general, on the worth of nature, see P. Dasgupta, *The Economics of Biodiversity: The Dasgupta Review* (2021). More specifically, on biodiversity hotspots, see R.A. Mittermeier, N. Myers & C.G. Mittermeier (eds), *Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions* (1999) and R.A Mittermeier et al. (eds), *Hotspots Revised* (2005). The new edition found nine additional hotspots to be added to the previous twentyfive.

[18] See, for instance, J. Lange et al., 'Wetland buffer zones for nutrients retention and cleaner waters', Factsheet 1/2021(https://www.greifswaldmoor.de/files/dokumente/Infopapiere_Briefings/2021_factsheet_Wetland%20buffer%20zones_final.pdf).

in terms of coastal protection and barrier to sea level rise has now gained higher value within the framework of climate adaptation measures and nature-based solutions.

The third scenario is financial impossibility (it would be technically possible to collect data and restore the environment, also by creating a new restored site, but it turns out to be too burdensome in terms of money, expertise, time).[19]

Third, even if it were possible to formulate the duty to restore in a precise manner (as a result of which the convicted defendant is fully aware of what his duties are according to the injunction) it also requires a follow-up on compliance by a public authority. Discussions can follow on the fact that the operator may try to capture the public authority in accepting restoration levels which are lower than optimal.[20] In the ideal case, the legal system should therefore define up to which level restoration would be required (for example in case of soil pollution) and how monitoring should be funded, providing certainty both to the operator as well as to the public authority that has to verify the compliance by the operator with the injunction.

Fourth, even if possible and followed by compliance, restoration may not always be sufficient to reach the goal of a full social costs internalization. Take again the example of the pollution of a wetland. Assuming for a moment that restoration by the operator were possible (which is of course highly doubtful), then restoration does not incorporate many aspects of social costs that have nevertheless been caused by the environmental pollution. This can more particularly be the case with so-called non-use values[21] that can have been endangered by the polluting act, but there may also have been interim losses[22] that occurred between the pollution and the moment of restoration. If an operator would only be forced to restore, there are many social costs caused by the pollution, not internalized by the operator. From an economic perspective that would mean that the operator does not have incentives to sufficiently invest in preventing environmental harm ex ante through the simple fact that restoration does not expose him to all social costs related to the pollution.

Fifth, precisely as a result of the uncertainty related to the passing of time (restoration often taking place much later than the polluting act, also making use of the natural capacity of regeneration of the environment), there may be dilution of the deterrent effect of being exposed to restoration costs.[23] The problem is precisely that those costs may be incurred many years after the polluting act as a result of which particular behavioural biases (such as overconfidence, over-optimism and hyperbolic discounting) could lead the potential polluter

[19] Clearly, the deterrent effect of restoration is linked to the likelihood of the polluter being aware about the possibility/impossibility of restoration. Missing information might otherwise lead to behavioural biases. The three scenarios and the availability of the information should be taken in mind for the design of optimal remedies.

[20] This might also happen with the choice of intense and environmentally harmful techniques of clean-up that can clean polluted sites very quickly. And not only the polluter, but also the insurer might make his private interest prevail. Lastly, the same authority might miss the incentive to compensate for the total economic value of nature knowing that the non-use value of nature will not be compensated in the end and/or nobody will claim for the environmental damage in the long term.

[21] Restoration of non-use values brings back to the issue of impossible ecological restoration that concerns biodiversity, for instance.

[22] That was described regarding the international oil pollution regime and the inaccurate compensatory restoration of interim losses under the EU Directive on Liability for Environmental Damage.

[23] The issue of the time lapse has been reported with regard to the application of the EU Directive on Environmental Liability. Likewise, polluters can expect delays in judicial decisions that are the consequence of a strategic use of litigation. This was reported in Italy and in France, for instance. In Italy, see Rapporto ISPRA, 'Il danno ambientale in Italia: i casi accertati negli anni 2017 e 2018' (2019).

to ex ante underestimate the likelihood that he will be exposed ex post to the costs of restoration. That phenomenon may again lead to a danger of too little ex ante investments in prevention and thus to an increase in the pollution risk.

Summarizing:

- restoration looks like an attractive remedy for the judiciary, being able to restore the harmed environment and avoiding the costs of monetizing environmental harm;
- it can certainly be useful in relatively straightforward cases, i.e. where it is possible to clearly identify the object of the duty to restore;
- restoration may, however, not work in more complicated settings where it is de facto impossible and
- a duty to restore alone may not provide sufficient incentives for ex ante investments in prevention in case the polluting act would also have caused other social costs, not incorporated in a duty to restore or the passing of time would result in behavioural biases.

3.2 DAMAGES

The advantage of the traditional remedy in tort cases (a duty to compensate for the harm done) is that it can in principle reach costs internalization, obviously on the condition that the damages do incorporate the full social costs. The most problematic aspect of damages is that imposing a duty on an operator to pay compensation does not lead to a restoration of the harmed environment. From an economic perspective, it could be argued that that is not necessarily problematic as long as damages lead to a full internalization of the social costs of pollution via the deterrent effect of having to pay damages. From an ecological perspective, the fact that the harmed environment would not be restored would of course be problematic, unless the victim would use the damages paid by the operator to subsequently restore the harmed environment. To the extent that victim is a public authority, bringing the lawsuit against the polluter, that might well be the case. However, there are other limits in damages which may equally make it difficult to reach an optimal cost internalization.

A first problem is that again not all social costs created by the pollution may be incorporated in the damages. In that respect, the difference between use and non-use values is again of importance. Use values can be measured through price-based techniques and revealed preferences techniques, such as travel costs and hedonic pricing (information from individual preferences in surrogate markets). Non-use values can be only measured through stated preferences techniques, such as contingent valuation and choice experiments (information from preferences expressed in hypothetical markets). To the extent that non-use values would not be correctly incorporated in the damage (and the same could be the case with interim losses), there would not be a perfect cost internalization. However, there are possibilities to monetize environmental harm and more particularly the non-use values, but those techniques are complicated, costly and debated. The problem posed by non-use values concerns the objective difficulties of converting non-use values in monetary terms so that social preferences can be elicited. The reason for that relies in the fact that they relate to non-monetizable costs, such as moral elements or other values that don't have an exchange equivalent. For this reason, scholars generally inferred that non-use values should be excluded from compensation.[24] Some also argued that non-use values cannot even be deemed

[24] L. Bergkamp, *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*, at 339 (2001).

as economic values.[25] A counterargument to that might be that the omission of non-use values would lead to serious under-compensation for unique, rare, ecologically significant and culturally valuable natural resources.[26] However, even if one would argue in favour of including non-use values in environmental damage assessment, issues still remain around the appropriate methodology to measure them. The debate on the reliability and validity of contingent valuation has been extremely lively in the last decades. The main points of criticism have been: the use of willingness to pay (rather than actual payments as a measure of value), potential biases in expressing the WTP after the accidental fact (rather than before), the nature of hypothetical market prices created through the survey (rather than real transactions).[27] For some scholars, CV surveys do not report economic values but more exactly feelings, attitudes and ethical values which are not economic measures of losses.[28] Therefore, the reliability of the method has been questioned by many scholars and further studies supported this lack of reliability showing gross variations in estimations through CV surveys. In the end, if the method is highly uncertain and it imposes excessive social and private costs, it would result both in economic inefficiency and injustice, especially if non-use values (option and existence values) are not agreeably a component of the total economic value of nature.[29] Given the controversies around the use of CV to assess environmental damages, the most followed way to assess environmental damages nowadays is to refer to market prices (where available) or restoration costs. This seems to be in line with the principles of law and economics according to which damage assessments should be conducted in such a way that: a) low transaction costs (feasible method) are reduced in litigation;[30] b) difficult-to-measure components of environmental harm are excluded from damage awards.[31]

Second, even though there may thus be economic techniques that could be employed to monetize environmental harm, another issue raised by monetary valuation is indeed given by the costs to undertake the study.[32] From a purely economic perspective, they should be avoided if they exceed the damage itself.[33] For this reason, it would make economic sense to undertake expensive environmental valuations to estimate the monetary value of the damaged natural resources only where the accident caused extremely high costs to the environment.[34] As a consequence, the usefulness of environmental liability would be drastically reduced. It is true that alternative and cheaper methods of monetary compensation are available (e.g.,

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[25] Stewart 1995, cited in Bergkamp 2001, at 342, footnote 366.

[26] Stewart 1995, cited in Bergkamp 2001, at 341, footnote 361.

[27] For a detailed list of problems raised by the contingen valuation, ibid, at 340-341.

[28] J.A. Hausman (ed), *Contingent Valuation: A Critical Assessment* (1993).

[29] S. Shavell, 'Contingent Valuation of the Non-use Value of Natural Resources', in J.A. Hausman (ed.), *Contingent Valuation: A Critical Assessment* (*Contributions to Economic Analysis), Vol. 220*, at 371 (1993). According to Bergkamp, tools which differ from liability would be better suited to reflect non-use values (Bergkamp 2001, 343).

[30] J. Kokott, S. Marr & A. Klaphake, 'Key Elements of a Liability Regime Taking into Account Ecological Damages', 2(4) *Journal for European Environmental & Planning Law* 277 (2005). See also: J. Kokott, A. Klaphake & S. Marr, *Ökologische Schäden und ihre Bewertung in internationalen, europäischen und nationalen Haftungssystemen – eine juristische und ökonomische Analyse* (2003).

[31] This principle is valid to the extent that the excluded (component of) damage is small. See Shavell, above n. 29. The reason is linked to the second problem raised by monetary damages, see *infra.*

[32] Under the ELD, "'costs' means costs which are justified by the need to ensure the proper and effective implementation of this Directive including the costs of assessing environmental damage, an imminent threat of such damage, alternatives for action as well as the administrative, legal, and enforcement costs, the costs of data collection and other general costs, monitoring and supervision costs" (Art. 2, §16)..

[33] Shavell 1993, above n. 29.

[34] Ibid.

benefit transfer method),[35] but they are likely to cause more errors because of their lower degree of accuracy. Therefore, accident costs that would be left uninternalized because of errors are more likely to outweigh the benefits (costs saved in litigation). Unluckily, the issue of costly (but accurate) monetary estimates has not been solved yet.[36]

The third issue is uncertainty about the population affected by environmental harm. This is very important because the process of environmental damage assessment is not aimed at measuring the unit average damage (through sampling), but the total amount of damages (through aggregation).[37] In other words, after it has been established how to determine the payment sufficient to compensate the unit,[38] the second step would be to aggregate damages across units in order to obtain the total value of damage. It is thus crucial then to identify those whose preferences matter and that should be included in the aggregation population because they suffered a real loss of welfare from the accident.[39] The uncertainty in the way in which judges would calculate damages can be problematic, both for the judiciary as well as with respect to the incentives provided by damages to the potential injurer.

Given all the difficulties mentioned so far, the judiciary may dislike the calculation of damages and would therefore, as we mentioned in the previous section, prefer restoration.[40] Restoration has the major advantage that it avoids information costs for the judge. Monetary compensation (damages) requires the judge to rely on (costly) assessment methods to determine the accurate amount of compensation. Also for potential injurers it may be difficult to predict the damages he would have to compensate in a case of environmental pollution. However, the literature has indicated that for optimal deterrence it is not necessary that in each individual case the amount of damages awarded precisely reflects the harm suffered by the victim; it is more important that damages are right on average; in that case still adequate

[35] In view of minimizing these costs, the White Paper originally endorsed the benefit transfer method rather than original valuation studies which are more time-consuming and resource-intensive. However, the accuracy of the method was at that time highly debated. On this point, S. Navrud and G.J. Pruckner, 'Environmental Valuation – To Use or Not to Use? A Comparative Study of the United States and Europe', 10 *Environmental & Resource Economics* 1 (1997).

[36] According to T. Swanson and A. Kontoleon, 'What is the Role of Economic Valuation in the Courtroom? The US Experience and the Proposed EU Directive' (2003), economic valuations of public goods in Courts are a 'poor substitute for adequate environmental regulation ex ante and ex post'.

[37] A. Randall, 'Whose Losses Count? Examining Some Claims about Aggregation Rules for Natural Resources', 15(4) *Contemporary Economic Policy* 88 (1997). (Welfare) economists think of natural resource damage assessment in terms of Kaldor-Hicks compensation. That means to first determine the payment to compensate the unit and, then, to aggregate damages in order to obtain the total value of damage. Assuming that methods to estimate accurate and precise estimates of unit damages exist (i.e., set aside issues of measurement and the distinction between the value of damage and the willingness to pay to prevent an injury), much controversy has arisen regarding aggregation because of offsetting benefits and damages claimed by certain categories that should be excluded.

[38] Most of the debates about the assessment of natural resources damages concern this very first step. Yet, it must be recalled that the natural resource damage assessment in the US foresees a type A and a type B assessment based on the complexity of the injury. Type A assessments are much simplified and cheaper approaches.

[39] It should be noted that the economic concept of standing should be deemed as much broader compared to the legal one, which includes only those who suffered a legally compensable damage and that are therefore entitled to file a lawsuit.

[40] This has been empirically analysed in the US and despite the fact that US Courts were allowed by the law to adopt stated preferences methods to assess non-use values in litigation. See D.B. Thompson, 'Valuing the Environment: Courts' Struggles with Natural Resources Damages', 32(1) *Environmental Law* 57 (2002).

behavioural incentives for prevention are provided to polluters.[41] For optimal deterrence the potential polluter should be able to predict ex ante to what extent he will be exposed to the full costs of the polluting act in order to take the corresponding optimal preventive efforts. The behavioural incentives provided through damages may have the advantage that they provide a clear monetary signal ex ante to the potential polluter (obviously assuming that the judge is able to accurately assess the damages and that the potential injurer is aware of this assessment) whereas in the case of restoration (which may also take place at a much later stage) it may be much harder for the polluter to assess the potential costs of restoration, especially in the cases of complex and impossible restoration. Given that there is, moreover, rather a risk of underestimation of the restoration costs by the potential polluter (given behavioural biases), there may be an underinvestment in prevention in case of restoration.

3.3 COMMON PROBLEMS

There are several problems concerning the remedies in case of environmental pollution that may arise both with restoration as well as with damages, although they may work out differently with both remedies. We already pointed at uncertainty concerning the costs (of restoration or of damages), but also at the assessment costs. To recapitulate: when discussing damages we already mentioned that there is uncertainty inter alia concerning the population affected by environmental harm. However, also in case of restoration there can be many sources of uncertainty related inter alia to the question whether the environment should be restored until its pristine conditions,[42] whether restoration should also include the physical, chemical and biological conditions of a natural resource and whether restoration should include both the active and passive values of natural resources until recovery.[43] The uncertainty concerning the affected population not only affects the damages, but can equally be problematic in case of restoration. Based on the possible goals of restoration, ecologists tend to distinguish an ecosystem-centred approach from the so-called 'socio-ecological restoration'.[44] The former only look at restoring ecological health, while the latter simultaneously deals with social and ecological issues and their main goal is to jointly restore the interdependent social and ecological processes in a social-ecological system (SoES).[45] Socio-ecological restoration implies difficult choices between human well-being and ecosystem recovery, but it is more adapted to areas, like wetlands, coastlands and terrestrial

[41] The argument is made in a well-known paper by L. Kaplow and S. Shavell, 'Accuracy in the Assessment of Damages', 39(1) *The Journal of Law and Economics* 191 (1996); see also L. Kaplow, 'The Value of Accuracy in Adjudication: An Economic Analysis', 23(1) *Journal of Legal Studies* 307 (1994).

[42] The target of restoration is itself a debated issue in ecology. Although the concept of baseline or condition prior to the accident does not seem to be problematic, in reality many issues might arise. See J.P. Bakker et al., 'How to Define Targets for Ecological Restoration?: Introduction', 3(1) *Applied Vegetation Science* 3 (2000). Moreover, it is not so well-accepted to use quantitative targets. For a view challenging instead the use of quantitative targets in international law and supporting qualitative targets, see A. Cliquet et al., 'Upscaling ecological restoration: toward a new legal principle and protocol on ecological restoration in international law', 30(4) *Restoration Ecology* e13560 (2021). Under the ELD, the target is linked to the 'favourable conservation status' of species and habitats and the conservation status will be taken as 'favourable' based on population dynamics data, range of species and size of habitats. The use of such quantitative criteria is subject to criticism.

[43] See on these issues further KM. Ward, 'Restoration of Injured Natural Resources Under CERCLA', 18 *Journal of Land, Resources & Environmental Law* 99 (1998).

[44] For a clear definition and guidelines, see Gann et al., above n. 8.

[45] J.F. Fernández-Manjarrés, S. Roturier & A.-G. Bilhaut, 'The Emergence Of The Social-Ecological Restoration Concept', 26 *Restoration Ecology* 404 (2018).

ecosystems that have been historically shaped by humans and whose conservation and management relies on them.[46]

We also already mentioned that both remedies may suffer from high assessment costs. It was already mentioned that assessing damages in environmental cases can be very costly. The techniques to value environmental losses are also heavily debated, as mentioned before. But also the costs of restoration are often debated. This not only concerns the costs of restoration itself, but also the costs to determine the optimal way of restoration. Restoration costs clearly depend on the available manpower and equipment, on the level of technology and, hence, indirectly on the agency's budget, the frequency and volume of injuries to be tackled.[47] Clearly, costs of restoration are higher if one wants to achieve cost-effective remediation and optimal deterrence (also including costs of monitoring after the implementation of restoration plans).[48] Costs of restoration may be also higher due to the private interests of agencies and insurers responsible of clean-up activities and that are more driven by the interests of local communities to use again the injured environment (public authorities) or the interest to avoid claims for economic losses (insurers).[49] An additional issue is that the restoration cost approach may ignore the probability of natural recovery. If the environment has the potential of coming back to original conditions over a period of time and without the need of human intervention, then paying costs of restoration would be a waste of money and it would make sense just to pay interim losses until full (natural) recovery.[50] A very last point to consider about the costs of restoration is that decisions on restoration are unlikely to be automatized due to their complexity.

It may be implied from the above that decisions on restoration require a careful consideration of technical, scientific and financial issues. Therefore, the possibility of speeding up litigation by employing algorithms would not be applicable to restoration as a remedy. That seems to be possible only in case of monetary compensation.[51]

There are, however, two other issues common to both restoration and damages that should be mentioned. The first problem is that the probability of the pollution being detected could be lower than 1. According to the traditional Becker model, when the probability of detection is lower than 1, a remedy should be higher than the potential benefits to the polluter in order to reach deterrence. That may be problematic in the case of restoration. If a polluter were only convicted to restore harm done (or for example to pay waste disposal fees avoided through

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[46] Ibid. In other words, if restoration is not precisely defined in the how, how much and to what extent, this is likely to be a discretionary judicial decision driven by the expertise of the judiciary and the appointed experts as well as by the results of the evidentiary phase in litigation, all factors that prevent polluters from knowing ex ante how much they have to pay for restoration.

[47] For instance, the costs of clean-up in the Exxon Valdez have been considered disproportionately high due to the use of intense techniques, whereas the costs of restoration after the Erika case or the Prestige case have been particularly high due to the lack of a regulatory framework on emergency responses and the clear definition of competent authorities.

[48] It was estimated that the costs of restoration in case of reforestation might range from a minimum of $ 1,400/ha in case of natural regeneration to something like $ 34,000/ha for large scale active restoration. See R. Crouzeilles *et al.*, 'Ecological Restoration Success is Higher For Natural Regeneration Than For Active Restoration in Tropical Forests', 3(11) *Science Advances* e1701345 (2017).

[49] See C.F. Boudouresque, A. Blanfuné, G. Martin, M. Perret-Boudouresque, I. Taupier-Letage, 'The Virginia Oil Spill In Provence: A Tale Of Inappropriate Over-Cleaning', Rapp. Comm. int. Mer Médit., 42, 2019, p.100 ⟨hal-03065573⟩.

[50] It might be even argued that from the perspective of nature recovery the costs of restoration can be a total waste of money if restoration is not followed by proper monitoring. In fact, the restored vegetation might not survive in the long-term, hence making the original investment useless.

[51] Like in the US legislation on environmental liability and Type A assessment.

the crime), optimal deterrence would not be reached if the probability of detection is lower than 1. The same problem would arise in case of damages, unless damages could be punitive to compensate the lower probability of detection.[52] In fact, this is a problem both for restoration as well as for damages and points to the need of having ex ante regulation based on the criteria for safety regulation by Shavell.[53] The limit of a civil environmental liability regime is that it does not provide optimal deterrence when the probability is less than 1.

Another common problem to both remedies is the insolvency risk. The assumption that potential polluters will be deterred by either the threat of a restoration or the payment of damages supposes that potential polluters are able to pay the restoration costs or the damages. In case of restoration costs or damages being higher than the polluter's wealth, a so-called judgment-proof problem arises with, again, underdeterrence as a result.[54] Insolvency can endanger optimal deterrence for both remedies. The answer is that environmental liability should be accompanied with mandatory solvency guarantees (such as for example compulsory liability insurance) in order to remedy the potential underdeterrence caused by the judgment-proof problem.[55]

4. SUMMARY: OPTIMAL ORDER OF REMEDIES

At the policy level a few conclusions can be reached on the optimal order of remedies, more particularly as far as the choice between restoration and damages is concerned.

4.1 STARTING WITH RESTORATION

If one were to develop a pyramid of remedies, a starting point could be that wherever this is

(1) technically, ecologically and financially possible

(2) and cost-effective[56]

restoration should be ordered.

The main reasons have been advanced above: it first of all satisfies the ecological goal of restoring environmental harm and it makes use of the lower information costs of restoration for the judges, thus avoiding the difficult monetary evaluation of environmental harm. Third, restoration could (in theory and under some circumstances) be less sensitive to insolvency as it in principle does not require a monetary payment from the defendant but an action.

In addition, the judge should impose a penalty payment as an enforcement mechanism, i.e. a payment that will only be done e.g. for every day that there would be a delay in the execution of the injunction. Obviously, the public authority has to be involved in enforcing the injunction and more particularly in monitoring the effectiveness of the restoration as ordered.

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[52] In law and economics, the low probability of detection has always been advanced as the most important rationale for punitive damages. See R. Cooter, 'Economic Analysis of Punitive Damages', 56 *Southern California Law Review* 79 (1982).

[53] Shavell, S., 'Liability for harm versus regulation of safety', Journal of Legal Studies, 1984, 357-374.

[54] S. Shavell, 'The Judgement Proof Problem', 6 *International Review of Law and Economics* 45 (1986).

[55] See B. Mamutse, 'Environmental Liabilities in Insolvency - An Area Ripe for Return?', 8(3) *International Journal of Law in the Built Environment* 243 (2016); C. Mackie and V. Fogleman, 'Self-Insuring Environmental Liabilities: A Residual Risk-Bearer's Perspective', 16(2) *Journal of Corporate Law Studies* 293 (2016).

[56] Obviously realizing that this may be hard to assess for a judge.

Alternatively, local communities could be involved in the attainment of restoration if they contribute to restoration with their work.[57]

Lastly, clear guidelines and rules should be introduced to avoid intense clean-up techniques that might be environmentally harmful and to allocate responsibilities across public bodies and to make sure that emergency responses are adopted within short and precise timeframes.

However, for the reasons mentioned above, restoration alone will not be able to be a remedy neither for restoring the environment, nor for internalizing social costs for a variety of reasons: in some cases restoration may be impossible; restoration can sometimes be too costly or there may be high uncertainty concerning the optimal way of restoring. Moreover, particular social costs (more specifically non-use values and interim losses) are usually not covered via restoration. In sum, to the extent that restoration is possible it can serve the ecological goal of restoring the environment, but cannot necessarily reach the goal of deterrence. As the polluter is not fully exposed to all social costs, there may not be an optimal internalization of the externality, nor optimal incentives for prevention. As a result, any restoration measure (in the cases where it is cost-effective and possible to impose it) should be combined with:

4.2 DAMAGES

This remedy comes especially in the picture in the case where restoration is impossible or not cost-effective. The damages should then be calculated in such a manner that they fully incorporate all social costs. There are obviously uncertainties and difficulties in determining these social costs. However, the judge can be assisted in this cost assessment through classic (but debated) instruments for valuing environmental harm, but also by newer techniques such as the ecosystem service valuation database (ESVD).[58]

In specific cases damages should be added as a supplementary remedy to restoration to the extent that restoration does not cover the full social costs.

This could be avoided by adding the injunction to restore other ecosystems with a cost equal to the interim loss (solution under the ELD). But the practice shows that compensatory restoration may be grossly inaccurate when ecosystems of the same tipe, quality and quanity of those destroyed are not available. Moreover, if interim losses are calculated through non-market traditional methods, non-use values are underestimated even where compensated in-kind. So, restoration projects should be scaled based on the most accurate methods of valuation (stated-preferences). If this is too expensive relative to the loss, then monetary awards should be better based on the ecosystem service valuation database (ESVD) that provides aggregated data on the values of ecosystem services.[59]

4.3 FINANCIAL GUARANTEES

Even in the case when the amount of damages due by the defendant is equal to the harm (and there are no punitive damages to outweigh the low probability of detection) there may still be

[57] On the efficient involvement of local communities for the success of ecological restoration, see B.J. Richardson, *Time and Environmental Law,* ch. 4 'Rear Vision', at 187ss (2017).
[58] https://www.esvd.net/
[59] The assessment should rely on objective factors, such as the harmed ecosystem (and its non-use value in monetary terms).

an insolvency risk. As mentioned, the insolvency risk might be reduced in case of restoration as the defendant is not required to pay, but to engage in action. It has been well-documented in the literature that insolvency is detrimental for both goals of remedies in environmental law: it will lead to underdeterrence and it will endanger the restoration.[60] As a result, mandatory financial guarantees have to be determined ex ante like for example compulsory liability insurance.[61]

4.4 REGULATION

As was made clear above, as the probability of detection of pollution is often less than 100%, liability rules cannot provide perfect deterrence. This is one of Shavell's classic criteria in favour of ex ante safety regulation.[62] A remedy is necessary to outweigh the low probability of detection. This can either be satisfied via punitive damages[63] or via administrative fines.[64]

4.5 CRIMINAL LAW (FOR UNIQUE IRREPLECEABLE ECOSYSTEMS)

If, however, the administrative fines would have to be set at a level higher than the wealth of the perpetrator (for example because the benefits from pollution are substantial or the probability of detection is really low) than non-monetary sanctions have to be employed,[65] which may need the intervention of the criminal law.[66] One of these remedies would be particularly needed to avoid irreversible or irremediable harm to the environment, such as the harm to unique natural resources and to extremely complex ecosystems for which primary restoration is not feasible and compensatory restoration would be extremely inaccurate. The considerably high value of such unique and irreplaceable natural resources would indeed justify the higher social costs of criminal laws.

5. THE EU DIRECTIVE ON ENVIRONMENTAL LIABILITY

We will now present an example of how the law deals in practice with remedying environmental harm to verify to what extent the model of the optimal use of remedies that we have just sketched is actually applied and which practical questions may arise in that respect. The example is from legislation, more particularly the European Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (ELD).[67]

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[60] See generally Shavell (1986) and B.J. Richardson, 'Mandating Environmental Liability Insurance', 12 *Duke Environmental Law and Policy Forum* 293, at 332 (2002).

[61] See P.J. Jost, 'Limited Liability and the Requirement to Purchase Insurance', 16 *International Review of Law and Economics* 259 (1996) and M.G. Faure, 'Economic Criteria For Compulsory Insurance', 31 *The Geneva Papers on Risk and Insurance* 149 (2006).

[62] For a summary see M.G. Faure and R.A. Partain, *Environmental Law and Economics: Theory and Practice*, at 189-190 (2019).

[63] Cooter, above n.52.

[64] See M.G. Faure, A.I. Ogus & N.J. Philipsen, 'Curbing Consumer Financial Losses: The Economics of Regulatory Enforcement', 31(2) *Law and Policy* 161 (2009).

[65] S. Shavell, 'Criminal Law and the Optimal Use of Nonmonetary Sanctions as a Deterrent', 85(6) *Columbia Law Review* 1232-1262 (1985).

[66] R.A. Bowles, M.G. Faure & N. Garoupa, 'Forfeiture of Illegal Gain: An Economic Perspective', 25(2) *Oxford Journal of Legal Studies* 275 (2005).

[67] OJ L143 of 30 April 2004.

5.1 THE ELD

Within the ELD there is a crucial role for public authorities.[68] Article 5(1) imposes an obligation on an operator to take necessary preventive measures where environmental damage has not yet occurred, but there is an imminent threat of such a damage occurring. When environmental damage has occurred Article 6(1) applies and the operator has to inform the competent authority of all relevant aspects and take practical steps to control the relevant contaminants and take the necessary remedial measures. It is the authority that can require the operator to take the necessary preventive and remedial measures.[69] According to Article 8(1), the operator shall bear the costs of the preventive and remedial actions taken pursuant to the Directive. The obligation to compensate for the costs (in other words the liability) is constructed in a complicated manner: for so-called Annex III-activities there is strict liability, whereas for all other occupational activities a fault/negligence regime applies.[70]

The literature holds that the ELD therefore adopts a system of a more administrative nature, rather than a pure civil liability approach;[71] the ELD opted for a system of public liability with a competent authority being primarily responsible for making the environmental liability work in practice.[72] Although the ELD uses legal terms that are characteristic for civil liability, such as fault and strict liability, it is in essence a public or administrative law regime.[73] The liability regime is solely enforced by public authorities; private parties cannot bring any claim against a liable operator.[74] There is, however, no formal obligation for administrative authorities to take action against operators. The extent to which the goals of the ELD (implementing the polluter-pays and preventive principles) can be met, thus depends upon the action taken by administrative authorities. Jans and Vedder indicate that according to Article 8(2) the competent authority is obliged to recover the costs arising from preventive or remedial measures it has implemented itself.[75] However, Article 8(2) continues that the competent authority may decide not to recover the full costs where the expenditure required to do so would be greater than the recoverable sum or where the operator cannot be identified. Jans and Vedder argue that the reference to cost effectiveness in this context is misplaced. Since environmental liability should have a preventive effect and implements the polluter-pays-principle "It is our opinion that the costs should always be recovered".[76] However, there is no formal way to force the competent authority to take action. Natural persons or NGOs can on the basis of Article 12(1) of the ELD submit observations relating to environmental damage or an imminent threat to the competent authority and according to

[68] For the purposes of this contribution, we will of course not discuss the ELD in full detail, but only focus on the remedies it provides. For more details see inter alia Cassotta 2012, 39-104 and see the contributions in Bergkamp & Goldsmith 2013.

[69] Jans, J.H. & Vedder, H.H.B., *European Environmental Law. After Lisbon*, 4th edn., Groningen, Europa Law Publishing, 2012, at 387.

[70] Ibid., at 386.

[71] So Liu, J., *Compensating Ecological Damage. Comparative and Economic Observations*, Antwerp, Intersentia, 2013, at 219.

[72] So Jans & Vedder, above n. 69, at 387.

[73] So Brans, E., 'Fundamentals of liability for environmental harm under the ELD', in Bergkamp, L. & Goldsmith, B. (eds.), *The EU Environmental Liability Directive. A commentary*, Oxford, Oxford University Press, 2013, at 38.

[74] Ibid.

[75] Jans & Vedder, above n. 69, at 388.

[76] Ibid.

Article 13 there should be judicial review of the legality of decisions, acts or failure to act of the competent authority.

There is no mandatory solvency guarantee within the ELD. Article 14 of the ELD only requires the Member States to promote the development of financial security instruments and the Commission to present a report on the availability of such instruments.[77] The result is that in some Member States there is a duty to seek financial cover, but in others there is not.[78] Meanwhile there have been a variety of studies addressing the possibility to improve financial security in the context of the ELD, the most recent one of March 2020.[79]

This brief overview of the remedies in the ELD shows that there is a strong focus on restoration. The ecological goal of remedying environmental harm is therefore the main goal of the remedies provided in the ELD. However, the question arises whether under the ELD potential polluters are ex ante sufficiently exposed to the full costs. Here the problem arises that the liability of the operator under the ELD may be limited to the costs of restoration. Other social costs, more particularly so-called non-use values or interim losses are not incorporated and there does not seem a possibility to impose damages on the operator beyond the duty to pay restoration costs. In addition, the ELD does not contain mandatory solvency guarantees. In sum: the remedies in the ELD are problematic from both perspectives: there is no exposure of the operator to the full social costs of pollution and therefore no optimal internalization of the externality; there is a focus on restoration, but in fact there is no guarantee of an effective restoration within the ELD as restoration may fail in case of insolvency of the operator in the absence of solvency guarantees.

6. CONCLUSIONS

The starting point for our contribution was the observation that increasingly there seems to be a focus in environmental law on restoration as a remedy in case of environmental pollution. That seems to be attractive at first sight to the extent that it will lead to remedying the harmed environment. We argued that environmental law and policy can benefit from the insights of economics to the extent that economics has stressed that the remedy should also be shaped in such a way that it provides potential polluters ex ante incentives for cost internalization. The danger of a too strong focus on restoration is that the other goal of environmental remedies (cost internalization) may be lost out of sight. However, we equally indicated that it may be difficult in practice to reach both the goals of restoration as well as cost internalization with the traditional remedies available. Determining damages may sometimes be too costly and a mere focus on restoration may not provide sufficient incentives to the operator. It is for that reason that we advocated a model for an optimal mix of remedies for environmental harm, combining the remedy of restoration with damages.

We subsequently showed by presenting one case study that the legal system may not always be sufficiently aware of the need to combine various remedies in order to reach both the goals of restoration and cost internalization. The example of the ELD in the EU showed that there

[77] Liu, above n. 71, at 290.

[78] For an overview see *inter alia* Bergkamp, L., Herbatschek, N. & Jayanti, S., 'Financial security and insurance', in Bergkamp, L. & Goldsmith, B. (eds.), *The EU Environmental Liability Directive. A commentary*, Oxford, Oxford University Press, 2013, at 132-135.

[79] See Fogleman, V., Stevens and Bolton LLP. Improving Financial Security in the Context of the Environmental Liability Directive, No. 07.02.03/2018/789239/SER/ENV.E.4, March 2020, Study prepared for the European Commission.

might be a too strong focus on restoration as a result of which potential operators may ex ante not be fully exposed to the costs of their polluting activities. For this reason, it is necessary to further incorporate economic insights into a smart design of remedies in environmental law.

Obviously we could only sketch the importance of a smart design of remedies, but there are still many points we could not address and which may be relevant for further research.

One question is for example why judges are that reluctant to apply economic valuation methodologies or the values of ecosystem services although information on how to apply those methods are clearly presented to them (like in the ICJ or in US courts).

The analysis could also be enriched by a behavioural approach. We strongly based our analysis on the assumption that potential polluters will rationally react to the incentives provided by different remedies; it would equally be interesting to examine whether particular biases might affect the way in which the remedies give incentives to polluters to prevent environmental harm. We could merely allude at the importance of for example hyperbolic discounting and over-optimism, but the effects of those biases are certainly worth further (empirical) research.

Finally, the imposition of a restoration measure supposes the involvement of a public authority that also verifies whether the polluter has complied with the restoration order imposed by the judge. That supposes not only that the standards for restoration in a particular case are clear, but also that public authorities have the information and capability to verify compliance with the order and that they act in the public interest. It certainly merits further research to examine whether those conditions are under all circumstances met in particular legal systems and if that were not the case what would be done to improve their functioning in order to improve the effectiveness of the restoration order. As we tried to make clear in this chapter: that is important not only for an effective remediation of environmental harm, but equally to provide optimal incentives for prevention to potential polluters.

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