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Blue Planet Law

The Ecology of our Economic and Technological World

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Maria da Glória Garcia • António Cortês
Editors

Blue Planet Law

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RESEARCH CENTRE
FOR THE FUTURE OF LAW
LISBOA

Plataforma
de **Apoio à Investigação em Direito**
na Católica

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Preface

The '*realisation*' that the technological and consumer society has a negative impact on the global environment and the '*discovery*' that human actions on the '*blue planet*' needed to be reshaped were a product of the *Stockholm Conference* (1972), held under the auspices of the United Nations. Indeed, the *Declaration of the United Nations Conference on the Human Environment*, approved at the end of the conference, on 16 June 1972, states: *Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations.*

It is not surprising that, in the last 50 years, scientific and technical knowledge has expanded rapidly in a wide variety of fields, at the same time forcing the emergence of new fields. Moreover, these last 50 years have shown that not only does '*our common future*' (the Brundtland Report, 1987) depend on reshaping human activity, but also we need to act fast: the fight against poverty and over-consumption goes hand in hand with efforts to halt climate change, biodiversity loss and ocean degradation. The global ecological crisis and, more recently, pandemic risks have also demonstrated that the responsibility lies with all of us and a profound change in behaviour is required. The law, the economy and public policy must keep pace with scientific and technical progress.

The way ahead is for contractualism to be rediscovered at the global political level, with the involvement of States, international and business organisations and non-governmental bodies, aiming to achieve UN Sustainable Development Goals 13, 14 and 15. An important role will be played by the *Global Pact for the Environment*, which synthesises in a unified system the environmental rights, duties and principles developed on the basis of the Stockholm and Rio Declarations, and which is being negotiated at UN level in order to gain conventional binding force. United by the future *Global Pact*, States, international organisations and other entities will more decisively commit to implementing all the environmental rights, duties and principles within their own legal and economic systems, under the control of the courts or non-judicial bodies, with constantly updated scientific and technological knowledge.

The purpose of this book is to commemorate this half century of life of the Stockholm Conference and reflect on the way forward, in search of a *Global Law of the Earth Ecosystem*. Hence the title, *Blue Planet Law. The Ecology of our Economic and Technological World*.

The works aim to move towards global, holistic thinking, in the knowledge that '*everything depends on everything*'. Transdisciplinarity and scientific dialogue are not, therefore, seen as challenges, but rather as ways of establishing thinking that seeks future-oriented integrated solutions, given that the questions are many and varied, and all in need of answers. What can law do to avert climate change, protect the ocean and prevent biodiversity loss? How can we develop economies and new technologies sustainably to safeguard the environment, while also making rational use of existing natural resources? What legal framework should govern biotechnology?

Blue Planet Law is divided into four parts.

Part I, on the Foundations of Global Ecological Sustainability, contains five chapters that set the context. Adopting a general approach, these address the issue of the ecological sustainability of post-industrial societies of the Anthropocene dominated by economic, scientific and technological progress, in terms of both International Law, essentially based on the sovereignty of States, and European Union Law. This part verses on the urgent need for a new ethical or philosophical vision of environmental responsibility that is decisively assumed as a common good of all humanity also taking future generations into account.

Part II deals with specific issues of environmental sustainability linked to protection of the climate, the ocean and biodiversity. Pollution and climate change are considered from scientific, economic and ethical perspectives, and also from a legal viewpoint, in terms of the applicable principles, effective means or judge-made law. This part also addresses issues relating to degradation of the oceans and the loss of marine diversity, which raise specific problems regarding the protection of areas beyond national jurisdiction, preservation of coral reefs and implementation of marine protected areas.

Part III focuses on specific policies aimed at ecological sustainability. Replacing fossil fuels with renewable energy, elimination of plastic waste and the development of an economy of the sea and sustainable fisheries are all decisive issues in the environmental policies of the Anthropocene. These cannot be resolved by sanctions alone, but require environmental laws and policies that influence behaviours and markets, such as green taxes, energy certificates and ecolabels.

Part IV is concerned with law, genetic resources and biotechnology. Biotechnology transforms or makes use of living beings and genetic resources for human purposes and will become crucially important in the twenty-first century. This part is focused on the opportunities opened by marine genetic resources and marine bioprospecting, as well as on the use of biotechnology for the purposes of energy efficiency, human health and food safety, dealing also with the limits of genetic engineering from the perspective of health and environmental protection.

The possible futures for our planet are many, but the future that becomes the present will involve philosophical, scientific, technological, economic and legal reflection. This book is a contribution to that reflection.

Lisbon, Portugal
5 June 2022

Maria da Glória Garcia
António Cortês

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To the authors—and there were many (33) who contributed with articles for the book—the coordinators are grateful for the enthusiasm with which they embraced the project and gave the best of their expertise, patiently responding to all requests, and always seeking to improve and meet the desired goals. To Magda Coelho, who creatively prepared the book of abstracts and gave shape to the hope of producing the book, the coordinators also extend their thanks. To Michelle Wells, who patiently and competently revised the English language of all the articles, the coordinators express their gratitude for her precious contributions. Our thanks are also extended to the company AJE Help Center that standardised the articles to meet the required rules of style. To Elsa Vaz de Sequeira, Director of the *Católica Research Centre for the Future of Law,* the coordinators are grateful for the promptness with which she always responded to our requests and, over the time of planning the work, heeded our concerns, heightened by the pandemic and the lack of support staff.

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Part I

Foundations of Global Ecological Sustainability

Blue Planet Law and Ecological Sustainability in the Twenty-First Century

António Cortês

Abstract

In the twenty-first century, the international community and states face the challenge of reconciling the economic and technological development of our post-industrial societies with the prevention or mitigation of global environmental problems such as climate change, ocean degradation, and biodiversity loss. Nowadays, international environmental law leaves up to the sovereignty of each state most of the measures necessary to prevent pollution, ecosystem degradation, and unsustainable use of natural resources. An important step, together with other international and national efforts, towards the transition to a more globalised and effective environmental law, a Blue Planet Law, will be the approval of the Global Pact for the Environment, which is being discussed at UN level. The Pact, along with other new international environmental conventions, will provide a legal framework that will help promote more effective ecological sustainability and preventive responsibility, considering namely the precautionary principle and intergenerational equity. The development of a Blue Planet Law, a Global Law of the Earth Ecosystem, is as urgent now as Human Rights Law was after the Second World War, and, in the next decade, it will be a crucial element for international and domestic implementation of the Agenda 2030 UN Sustainable Development Goals.

Keywords

Blue Planet law · Global environmental crisis · Ecological sustainability · International environmental law · Global Pact for the Environment · Global and future oriented responsibility

1 Introduction

One of humankind's greatest challenges in the twenty-first century is to reconcile the economic and technological development of our post-industrial societies with the prevention or mitigation of global environmental problems such as climate change, ocean degradation, and biodiversity loss. The delicate equilibria of the whole biosphere, on which human life, health, food, and well-being depend, are at risk. Therefore, a Blue Planet Law, a new Global Environmental Law, which fleshes out the ecological dimension of sustainable development, is necessary. Our text intends to contribute to overcoming the difficulties of the current international environmental law, in view of the transition towards a new environmental law clearly characterised as "global" and "future-oriented".

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We will first develop the idea of a Blue Planet Law, in the context of the Anthropocene (Sect. 2). Subsequently, we will demonstrate that the existing International Environmental Law is, for several reasons, insufficient to solve the main problems of the global ecological crisis (Sect. 3). Afterwards, we will defend the urgency of approving the Global Pact for the Environment, which is being discussed at UN level and includes a strong emphasis on the universal duty to take care of the environment and on the principles of prevention, precaution and intergenerational equity (Sect. 4). Finally, we will stress the importance of the role of the Blue Planet Law in strengthening the environmental component of the UN Sustainable Development Goals (Sect. 5).

2 The Idea of a Blue Planet Law in the Twenty-First Century

We are living a new geological age characterised by the physical, chemical and biological impact of human activities on the Planet as a whole: "the Anthropocene" (Crutzen and Stoermer 2000). The Anthropocene is the "age of humans"; "for the first time in our history the most serious and immediate, even existential, risks are human-made and unfolding at planetary scale" (UNDP 2020, p. 20). The relationship between humankind and nature has definitely changed; "the frontiers of the natural and the artificial have become increasingly diluted and everything or almost everything, from the climate to biological diversity" seems to be "under humankind's power" (Ost 2003, p. 266). With modern technology the "nature of human action has *de facto* changed" and we have acquired an immense power over "no less than the whole Biosphere of the Planet" (Jonas 1985, p. 7); "man has become dangerous not only to himself but to the whole Biosphere" (Jonas 1985, p. 136).

The former geological age, the Holocene, was characterised by a certain stability and equilibrium of ecosystems. The industrial revolution constitutes a turning point in the relationship between humankind and nature. In fact, "with the advent of the industrial society, production, that is to say the transformation of nature, was considerably intensified in comparison with the previous centuries. For the first time in human history, the relationship between humankind and the natural world would experience a complete rupture" (de Sadeleer 1993, p. 168). Indeed, "all nature today has been shaped by human action or is affected by human activities" (Biermann 2021, p. 65). Moreover, human activities are not always carried out sustainably and consequently they are threatening or endangering the natural equilibria that sustain the life conditions—including human life, health and food—on Earth.

The path of economic, scientific and technological progress after the industrial revolution brought with it increasing human pressure on the planet, which translated to degradation of ecosystems and unsustainable use of natural resources. Ultimately, resources have become limited due to "the growth of human populations and their ever-increasing demands for material goods and economic growth, set against the physical capacity of the planet Earth" (MacCormick 2011, p. 139). Economic and industrial growth has greatly enhanced the quality of human life, but it has also produced new environmental problems, with an international or global impact, such as "climate change and ozone depletion, loss of biodiversity, toxic and hazardous pollution of air and sea, pollution of rivers and depletion of freshwater resources" (Sands and Peel 2019, p. 3).

Our civilisation is dominated by the idea of unlimited economic and technological development, and humankind is endangering the sustainable use of natural resources and the delicate equilibria of the ecosystems and the Earth Ecosystem as a whole. In fact, the techno-economic paradigm is dominated by the "idea of infinite or unlimited growth, which proves so attractive to economists, financiers and experts in technology" (Francis 2015, p. 106). However, the logic of development has overshadowed sustainability standards and the result, as stated above, is massive pollution, hazardous and non-recyclable waste, degradation of air, water and soil quality and unsustainable exploitation of natural resources.

There is a tendency to act as if economic growth and mass use of mechanical, physical and chemical technology will have no negative impact on biodiversity and ecosystems or as if the inherent risks will be a negligible evil. However, the risks of our techno-economic societies are becoming increasingly significant, serious and irreversible, and are producing impacts that are both planetary and long-term.

Thus, a paradigm shift is needed. The dominant economic and technological paradigm must take serious account of ecological sustainability and global ecological responsibility. We must have new economies and new technologies. We must promote eco-friendly economies and eco-friendly technologies, "sustainable" economies and technologies. What is at stake is obviously not simply the strict prohibition of human activities that endanger or damage the environment, but rather the implementation of a complex legal strategy that nudges economic, ethical and political behaviour, supposing scientific knowledge and aiming at certain objectives.

A new kind of law must emerge, a law that takes global ecological sustainability and preventive ecological responsibility seriously, a Blue Planet Law—a global law that does not renounce economic and technological development, but gives sufficient consideration to sustainability standards and human responsibility for the future of the "Earth's Ecosystem",[1] the future of this Blue Planet where humankind lives in communion with other forms of life, other living species.

Scientific and technological power and economic industrialisation "manipulate nature and change it according to human will. In doing so, they threaten nature, put it at risk, concur with its degradation and make it more fragile. By making nature fragile, they create a new object of responsibility for humankind" (Garcia 2007, p. 72). Human responsibility is no longer simply a responsibility between contemporary and neighbouring human beings; it has also become a responsibility towards nature, distant people and future generations. Law must incorporate this demanding responsibility for the future. And the more fragile nature turns out to be due to the actions of humankind, the greater the latter's responsibility towards nature should be. Ecological responsibility has a future horizon. Ecological risks and harm must be anticipated and prevented. Our present responsibility is to avoid risks and harm not only in the near future, but also in the long term, in the distant future.

At the root of the global ecological crisis, we find an optimistic vision of nature and natural resources and a utopian vision of technological progress. On the one hand, nature would have an unlimited capacity to absorb pollution and regenerate ecosystems and natural resources. On the other hand, scientific and technological progress would make it possible for humankind to definitively become, in the words of Descartes, "the owner and master of nature" (Ost 2003, p. 43). This incorrect vision of nature and this naive utopianism regarding technological and economic progress have led us, in the first decades of the twenty-first century, to a deep ecological crisis on a planetary scale: the global ecological crisis.

Law must pay serious heed to the notion of the World Charter for Nature that "[hu]mankind is part of nature" (United Nations 1982). Although humans may dominate nature, they also depend on and are part of it, and their life, health, food and well-being depend on its fauna, flora, water, air, soils and ecosystems. Therefore, humans are vulnerable to the risks of destroying the environmental conditions of life on Earth.

The humanised biosphere in which we live is composed not only of "nature", that is, "realities that were not human-made" (Krebs 2016, pp. 340–341), such as animals, plants, rivers, soils, water and air, or oil, mercury or uranium, but also human activities and human artefacts, such as buildings, means of transport, industrial facilities, and electrical equipment. Humankind has been dominating and transforming nature

[1] The Convention on Biological Diversity, in Article 2, defines, the "ecosystem" as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit". The "Earth's ecosystem", to which the 2017 Draft Global Pact for the Environment refers, includes the interaction and the functional equilibrium of natural elements and human activities.

since the agricultural revolution, but, as we have seen, in the last two centuries the impact of that domination and transformation has progressed to a completely different scale and is jeopardising the delicate equilibria of the biosphere as a whole.

At the international level two different and powerful ideas can be seen as laying the foundations for environmental protection in the twenty-first century: "sustainable development" and "human rights". Yet in the sustainable development equation—involving economic, social and environmental development—economic growth has generally prevailed. We must, however, assume that sustainable development does not exist without robust and multiform legal protection of the environment on which human food, life and health depend. On the other hand, the logic of human rights, focused on individual liberty, must be complemented with the logic of necessary human responsibility for the whole biosphere.

Blue Planet Law is a synthetic name for the Global Environmental Law of the Anthropocene, characterised not only by the assumption that economic and technological activities are intrinsically human, but also by the idea that we must take ecological sustainability and global responsibility for the biosphere seriously. Green is the colour usually associated with the environment and environmental protection. We associate green spaces with nature and biodiversity. We speak of an EU Green Deal, of green taxes, green policies and so on. However blue is the colour that better symbolises the holistic and planetary character of the current environmental crisis and the Global Law needed to address it. In fact, some of the most serious global environmental problems of our time are related to the atmosphere and the ocean that make up planet Earth, the Blue Planet. Blue is the most common colour of the skies and the seas as seen from Earth in daylight and it is the predominant colour of our Planet as seen from outer space. And the most severe environmental problems that our techno-economic societies have to deal with in the twenty-first century have a holistic and planetary dimension. Therefore, the green symbols of environmentalism—plants, trees, recycling figures—should always be placed inside a blue circle.

3 The Global Environmental Crisis Between International Law and State Sovereignty

International law has to some extent incorporated the concepts of "common concern of humankind" and "future generations" (Bodansky et al. 2012, pp. 10–14). However, international environmental and economic law are still dominated by the idea that states have full sovereignty over their natural resources and territory (Segger and Khalfan 2006, p. 112). Therefore, it is difficult to agree on strictly binding rules or principles, especially regarding pollution and natural resources, not only within the territory of states but also in the "global commons".[2] Environmental common goods such as the climate or biodiversity are in fact recognised by international treaties as a "common concern of humankind" (Brunnée 2007, pp. 557–567; Dupuy and Viñuales 2019, p. 98), but their protection remains essentially dependent on the sovereignty and goodwill of the states.

Binding treaties setting out strict duties and obligations in environmental issues are often difficult to obtain, mainly because environmental protection always has an economic cost and states are not always willing to bear or impose that cost in their economies. On one hand, "big corporations and multinationals in developed countries are reluctant to adopt [eco-friendly equipment and measures] for fear that their production costs may dramatically soar or bring about a decrease in their competitiveness". On the other hand, "developing countries assert that, given their backwardness and poverty, they cannot afford to improve their conditions, unless they receive considerable financial [and technological] assistance from industrialized states" (Cassese 2005, p. 486). Moreover, the economic advantages of the "green economy" and the

[2] On the "global commons", Bell et al. (2017, p. 142).

"blue economy" are not sufficiently decisive, because the "transition" implies high financial costs for companies and states.

International environmental law is to a large extent "soft law"[3]—formally non-binding law, non-coercive law—although it might have some "legal effects", as typically happens with UN Conference Declarations and General Assembly Declarations (Boyle and Redgwell 2021, pp. 33–35). One very specific form of international soft law, as previously noted, is "Declarations" (Christiano 2015, p. 381), such as the 1972 Stockholm Declaration, the 1982 World Charter for Nature or the 1992 Rio Declaration, which enshrine a set of environmental law "principles". Another form of soft law is included in UN General Assembly Resolutions, such as the 2030 Agenda for Sustainable Development, which enshrines 17 Sustainable Development Goals (SDGs), including responsible production and consumption (SDG 12), climate action (SDG 13), and the preservation of life below water (SDG 14) and life on land (SDG 15).

Soft law instruments often act as a first step towards the subsequent adoption of international treaties or customary practices. An example of a soft law principle that has become customary binding law is the prevention principle "inferred" from the Stockholm Declaration (Principle 21) and the Rio Declaration (Principle 2) (de Sadeleer 2021, p. 88). Soft law principles have a symbolic effect and, as mentioned above, often pave the way for political and diplomatic efforts to adopt binding treaties, as well as providing standards to be applied in case law. For instance, the precautionary principle enshrined in the 1992 Rio Declaration (Principle 15) was included in the 1992 Framework Convention on Climate Change and in the Preamble of the 1992 Convention on Biological Diversity, and it was also later the leitmotif of the Cartagena Protocol on Biosafety, which regulates biotechnology. It has likewise influenced the case law of the International Tribunal for the Law of the Sea and of the WTO Dispute Settlement Bodies (de Sadeleer 2021, p. 138), and even the case law of the European Court of Human Rights (Dupuy and Viñuales 2019, pp. 72–73). However, soft law is, by definition, non-binding law in written form. It has a directive, guiding function, rather than strictly normative binding force.

Furthermore, although there are around 500 environmental law treaties (Aguila 2020, p. 9), many gaps remain, and treaties often have weak levels of 'bindingness'.

The 2018 UNSG Report "Gaps in international environmental law and environment-related instruments: towards a global pact for the environment" identifies various "issues as remaining without specific, legally binding regulation by international treaties", such as "the conservation and sustainable use of forests, pollution of marine areas by land-based plastic debris, protection of biodiversity beyond national jurisdiction, the protection of soils, regulation of the use of pesticides, regulation of noise pollution, protection of the Artic environment, a human right to biological diversity, regulation of nanomaterials" (Voigt 2019).

Moreover, and principally, "the legal 'bindingness' of a treaty provision depends on many factors", including: (i) "Where it occurs—in the preamble or operative part of an agreement"; (ii) "Who the provision addresses—states, collectively or individually, or others"; (iii) "Whether it uses mandatory or recommendatory language;" (iv) "How precise it is"; (v) "What institutional mechanisms exist for transparency, accountability, and compliance" (Bodansky et al. 2012, pp. 18–19). And the truth is that for the most important issues in international environmental law—such as climate change, biodiversity loss, ocean degradation—"framework agreements" prevail and there are usually no judicial procedures to deal with cases of non-compliance, only "supervisory and preventive mechanisms" (Cassese 2005, p. 487).

Let us see how international law currently deals with the main problems of the global ecological crisis: climate change, ocean degradation and biodiversity loss, including natural resources depletion.

[3] On *soft law* instruments in international environmental law, Dupuy and Viñuales (2019, pp. 40–41).

The most visible side of the global ecological crisis in the Anthropocene is climate change. Climate change implies atmospheric warming, extreme weather events and destruction of habitats needed for biodiversity. The Earth's temperature has increased 0.99% since the beginning of the industrial revolution and in the last 50 years has increased faster than in any 50-year period in the last 2000 years (IPCC 2021, p. 5). This leads to a variety of different risks and constitutes a serious global problem. The 2021 Glasgow Agreement "recognizes that the impacts of climate change will be much lower at the temperature increase of 1.5 °C compared with 2 °C [above pre-industrial levels]".[4] A very small difference in temperature makes a huge difference in the impacts of climate change—"a little is a lot" (Gates 2021, pp. 20–30).

Climate changes are the result of an alteration in the chemical composition of the atmosphere, more precisely, of an excess of greenhouse gases (GHGs) in the atmosphere, such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). According to the IPCC: "In 2019, atmospheric CO_2 concentrations were higher than at any time in at least 2 million years (high confidence), and concentrations of CH_4 and N_2O were higher than at any time in at least 800,000 years (very high confidence)" (IPCC 2021, p. 4). The causes of this excess are many, but it is possible to synthesise them. The basic idea may be reduced to an imbalance between GHG emissions and GHG sinks. The main cause of GHG emissions is the use of fossil fuels: "Electricity generation, heat production and transport rely heavily on fossil fuels and together account for roughly 70 per cent of global greenhouse gas emissions" (United Nations 2019, p. XXVI). Food production, especially bovine livestock and intensive agriculture, is responsible for around 18 to 19% of GHG emissions (Gates 2021, p. 55; Martins-Loução 2021, p. 36). On the other hand, GHG sinks are decreasing mainly due to deforestation, but also due to the loss of marine biodiversity.

The 1992 UN Framework Convention on Climate Change (UNFCCC) considers a stable climatic system a "common concern of humanity" and recognises that it "must be preserved through the control of anthropogenic interference in the atmospheric composition". However, the ultimate objective of the convention simply requires the adoption of measures by each state individually or in cooperation with other states. The 2015 Paris Agreement is more specific. The parties agree to reduce their carbon emissions, "holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change".[5]

However, this is only a "collective goal" and does not include specific targets for each state individually. In fact, it is up to each state to determine its "nationally determined contribution" (NDC) (Bodansky et al. 2017, pp. 231–236) to climate change mitigation. And, naturally it is also up to states to determine the specific legal measures to be adopted at the national or domestic level, such as the taxation of fossil fuels ("green taxes") or the provision of subsidies to "renewable energies", namely solar, wind and wave energy, or "green hydrogen" (which can be produced from ocean waters). Moreover, and consequently, the Paris Agreement foresees an "expert-based facilitative committee" to facilitate implementation of and promote compliance with the Agreement, but states that this mechanism should function in a "non-adversarial and non-punitive manner".[6]

Another dimension of the global environmental crisis in the Anthropocene is ocean degradation. The ocean is the world's largest ecosystem, covering almost three-quarters of the Earth's surface. This planetary ecosystem is a source of living resources (fish, algae, and marine genetic resources) and is an essential part of the Earth's

[4] Glasgow Climate Pact, n. 16.

[5] Paris Agreement, Article 2/1/a. See also Bodansky et al. (2017, p. 229).

[6] Paris Agreement, Article 15. See again Bodansky et al. (2017, p. 246).

life support. The ocean absorbs 25% of the CO_2 emitted by our fossil-fuel-based and industrialised economies, as well as 90% of the heat generated by that CO_2 and other greenhouse gases, but this represents "a triple threat to the ocean causing it to become warmer, more acidic and to store less oxygen", and it has a "substantial impact on the working of its biological systems" (Oceano Azul Foundation 2021, p. 21). Furthermore, global warming leads to a rise in sea levels, which implies not only the flooding of riverside cities and beaches but also the destruction of ecosystems in large river estuaries. Overfishing is endangering many species. In addition, the ocean has functioned as the world's dump, into which non-biodegradable residues are thrown, including gigantic amounts of plastic. Wastewaters from urban centres and waters containing hazardous substances from industries and pesticides from agriculture also flow into the ocean. These chemical substances not only degrade the ocean's water quality but also enter into food chains, affecting biodiversity and eventually human health and food safety.

The 1982 UN Convention on the Law of the Sea (UNCLOS) determines that states have the duty "to preserve and to protect the marine environment"[7] and that states "shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation".[8] These two provisions represent a "paradigm shift" (Tanaka 2015, pp. 265, 276) in the law of the sea since they recognise an explicit obligation to prevent pollution in the whole ocean and the obligation to take appropriate measures to preserve and manage natural resources within each exclusive economic zone (EEZ). However, international and national efforts "have not prevented the further deterioration of the oceans, the over-exploitation or depletion of marine species and the destruction of natural marine habitats" (Sands and Peel 2019, p. 565). Moreover, the ocean is subject to the "tragedy of the commons". In fact, unrestricted freedom of the seas still prevails in the High Seas as the new treaty on biodiversity beyond national jurisdiction (BBNJ)—which has been promised since 2015—is still being negotiated (Sands and Peel 2019, p. 565), and the establishment of EEZs in 1982 by the UNCLOS has also not prevented the tragedy of the commons in the areas under national jurisdiction,[9] because generally states do not have an extensive and adequate system of marine protected areas and fisheries management.

The other major global problem of the ecological crisis of our time is biodiversity loss (whether on land or in the ocean and rivers). This biodiversity loss also means a loss of natural resources: living and genetic resources. The reasons for protecting biodiversity are several: "First, biodiversity provides an actual and potential source of biological resources including, for example, for use as food and feed, as well as pharmaceutical, industrial and other applications [such as biotechnology]. Second, biodiversity contributes to the maintenance of the biosphere in a condition that supports human and other life. [. . .] Third, biodiversity conservation may be based on ethical, intrinsic, aesthetic and cultural considerations" (Sands and Peel 2019, p. 385). However, every year thousands of species of plants, animals and micro-organisms become extinct. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), "An average of around 25 per cent of species in assessed animal and plant groups are threatened, suggesting that around 1 million species [out of 8 million] already face extinction, many within decades, unless measures are taken to reduce the intensity of biodiversity loss. Without such action, there will be a further accelera-

[7] UN Convention on the Law of the Sea, Articles 192 to 194.

[8] Ibid Article 61, no. 2.

[9] I disagree therefore with the idea that the creation of EEZs by the UNCLOS prevented the tragedy of the commons in the ocean, as defended by Bell et al. (2017, p. 142).

tion in the global rate of species extinction, which is already at least tens to hundreds of times higher than it has averaged over the past 10 million years" (IPBES 2019, p. 4).[10] Scientists talk about a "sixth mass extinction" caused not by a natural event but by human action, by the impacts of our techno-economic civilisation. The problem lies mainly in the destruction and fragmentation of habitats where fauna, flora and micro-organisms live and develop. This degradation of habitats is associated with pollution, the expansion of urban and agricultural spaces, climate change, invasive species, and overexploitation of natural resources, including deforestation. Not even the great sanctuaries of biodiversity, namely the tropical forests (the Amazon or Congo river basins) and the coral reefs (which shelter around 1/4 of all marine biodiversity) escape this destruction.

The Convention on Biological Diversity (CBD) recognises, in its preamble, that the "conservation of biological diversity is a common concern of humankind", but it also affirms that "States have sovereign rights over their own biological resources" and that they "are responsible for conserving their biological diversity" (Dupuy and Viñuales 2019, p. 98), that is, the habitats and the species within their territory. Thus, the measures adopted for the conservation of biodiversity and biological resources depend essentially on the goodwill of each state. There are supranational efforts to protect ecosystems such as the Habitats Directive within the European Union, but there is no international control of the domestic implementation of land and marine protected areas. There is, in particular, an important UN project for a Global Agreement for Biodiversity, within the normative and institutional framework of the CBD, that proposes specific targets. These include the objective of "at least 30 per cent globally of land areas and of sea areas [. . .] conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas [. . .]" (Target 3) (UN Environment Program 2021, p. 6). Nevertheless, although this project constitutes an important step, an agreement is yet to be adopted, and the proposed goal is only a collective global goal, it remaining essentially up to each state to determine the domestic measures to be taken in order to contribute to that goal[11] and eventually the future negotiation of more specific international treaties on biodiversity protection.

Rachel Carson, the famous biologist and ecologist, warned us that "in nature nothing exists alone" (Carson 1964, p. 35). The same message has been purveyed by Pope Francis: "everything is interconnected [. . .] Just as the different aspects of the planet – physical, chemical and biological – are interrelated, so too living species are part of a network which we will never fully explore and understand" (Francis 2015, p. 138). Carbon and water cycles are global. Food chains and ecosystems have complex and delicate balances that can be affected by the introduction of a single polluting substance or by the extinction or rarefying of a single plant or animal species. Furthermore, in the Anthropocene, global environmental damage and losses often become cumulative and in many cases are irreversible, with dramatic consequences for future generations. The irreversible destruction of biodiversity has implications—as seen above—not only for the planet's beauty, but also for food and human health. Indeed, greater diversity within ecosystems equates to their greater resilience, fewer risks to their survival and a greater variety of food and genetic resources, namely for biotechnology and pharmaceutical applications. In turn, climate change can have tremendous consequences in terms of the destruction of ecosystems and fauna and flora, and also directly affect the quality of people's lives, as they increasingly become victims of droughts, high temperatures, forest fires and natural disasters.

Moreover, there is also the risk that the impact of human activities is steering the dynamics of the Earth ecosystem as a whole towards "tipping

[10] See also IPBES (2019, p. 15), which includes a figure with the "current global extinction risks by groups of species".

[11] On the different kinds of legal measures to protect biodiversity, Sands and Peel (2019, p. 386).

points" beyond which the negative consequences of environmental degradation become exponential and unstoppable—one may think of the melting of the polar ice caps on Greenland and the Antarctic. Finally, let us not forget that in the global ecological crisis it is not only air quality, climate, water and the intrinsic value of biodiversity that is at stake. Eventually, the severity of the global environmental crisis may also present a risk to humankind itself, that is, to human beings as biological, psychological and spiritual creatures, who have the right to life, food, health and a balanced and healthy environment.

4 The Global Pact for the Environment and the Universal Duty to Take Care of the Earth Ecosystem

In 2017, a group of over 100 world experts in environmental law, international law and sustainable development came together to prepare a Draft Global Pact for the Environment (DGPE) in 2018, this project was taken to the United Nations General Assembly and 143 countries voted a Resolution according to which negotiations should begin to transform this DGPE into an "international instrument" (Resolution of the United Nations General Assembly 2018) (only 5 countries voted against). This "international instrument" is to be a treaty, not simply a soft law instrument. In fact, the DGPE is explicitly a treaty proposal to be signed and ratified by the Parties, [12] including states and probably other entities such as the European Union.

The DGPE includes within its scope the main global environmental problems—climate, ocean and biodiversity—and unifies and systematises the international environmental law within a global law approach. It might be said that the Global Pact for the Environment (GPE) will be a keystone in the transition from classical international environmental law to a Global Environmental Law. In fact, approval of the GPE will consecrate a human right to an ecologically sound environment and a universal duty to take care of the environment that is addressed not only to every state and other international entities, but also to all other public and private, natural and legal persons. The Pact also enshrines the fundamental legal principles of environmental law that are supposed to be applied globally, that is, although in different ways, not only at the international level, but also at the domestic level.[13] Furthermore, the GPE will establish implementation mechanisms that point to a "global warrant", constituted by global or common practices that are not dependent on the territory of each state (Walker 2015, pp. 18–24). Finally, the GPE also intends to be global law in the sense that it concerns humankind as a whole, including future generations (Domingo 2011, p. 105).

The GPE will have a gravitational effect on all the existing environmental law and will clearly affirm the paradigm shift needed in environmental law. Firstly, it will recognise the global character of environmental law, by consecrating the human right to a sound environment and the universal duty to take care of the environment. Secondly, it will clearly establish a future-oriented environmental law based on the principles of prevention, precaution, and intergenerational equity. Thirdly, the implementation mechanisms of the GPE will operate not only at the international level but also at the domestic level. Let us now see in more detail how the GPE takes a decisive step in the legal paradigm shift that is necessary in the context of the global environmental crisis.

The first novelty brought by the DGPE is the consecration of the "right to an ecologically sound environment". According to Article 1, "Every person has the right to live in an ecologically sound environment adequate for

[12] See Draft Global Pact for the Environment, Articles 23 to 26.

[13] See Walker (2015, pp. 15, 71–86) on global law and the overcoming of the "Westphalian duo of national and international". See also ibid. 71–86 on the global character of human rights.

their health, well-being, dignity, culture and fulfilment".

Today the right to a healthy or sound environment is already directly protected in around one hundred national constitutions (Knox 2020, p. 83; Boyle and Redgwell 2021, p. 295), after the Portuguese Constitution[14] consecrated it for the first time (Bodansky et al. 2017, p. 303, fn. 38) in 1976, in the wake of the 1972 Stockholm Declaration.[15] At the international level, the 1998 Protocol of San Salvador and the 1981 African Charter on Human and People's Rights lay down, respectively, a "right to live in a healthy environment" and a "right [of all peoples] to a generally satisfactory environment favourable to their development". Nevertheless, there is no universal proclamation of a human right to a sound environment at the level of United Nations law (Knox 2020, p. 81). The universal consecration of a human right to a sound environment in the GPE will have a strong symbolic, normative and institutional impact in environmental law, representing in itself, to a certain extent, a displacement from the existing prevailing anthropocentric approach to a more ecocentric approach. In fact, the right to a sound environment supposes that the protection of the environment becomes direct, rather than simply indirect, i.e., dependent on the "greening" of other human rights, such as the rights to life, health, private life or property.[16] Moreover, the inclusion of the "environment" within the field of human rights brings the seal of legal universalism to a globally fragmented environmental law.

It is, however, true that the logic of human rights, focused on the human dignity of each person, is difficult to apply to the protection of animal and vegetal species or even to the protection of future generations (Bodansky et al. 2017, p. 300) or of humankind as a whole. However, the GPE will also consecrate a universal duty to take care of the environment. This duty to take care of the environment is the keystone of the GPE. The basic underlying idea is that, although nature has no rights, everyone has a "duty to take care of nature", and that presupposes "the care for humankind that comes after us [and] the care for everything that our Planet includes in its own constitution" (Kaufmann 1993, p. 382).

According to the DGPE, "Every State or international institution, every person, natural or legal, public or private, has the duty to take care of the environment. To this end, everyone contributes at their own levels to the conservation, protection and restoration of the integrity of the Earth's ecosystem".[17] The DGPE explicitly enshrines a universal "duty to take care of the environment" and the object of this duty to take care is also global. The environment is understood to be the "Earth's ecosystem", including climate, ocean and biodiversity.

This duty, as stated above, is the very core of the GPE, and is unpacked into different principles of ecological responsibility, of which we will only highlight those that embody the future-oriented responsibility that the GPE intends to strengthen: the principle of prevention, the precautionary principle and the principle of intergenerational equity.[18]

The GPE makes absolutely clear that the ecological responsibility that is at stake in the "risk society" of the Anthropocene is decisively an *a priori* responsibility rather than an *a posteriori* responsibility: it is a responsibility to avoid damage or losses before they occur. The reasons underlying this approach are easy to understand. The reparation of environmental damage is often difficult or highly expensive. Moreover, "there are hazards which, if they occur, would mean destruction on such a scale that action [or reparation] afterwards would be practically impossible". Therefore, we must "become active today in order to prevent, alleviate or take precautions against the problems and crises of tomorrow and the day after tomorrow" (Beck 1992, p. 30). Economic activities and mechanical

[14] Article 66.

[15] On the impact of the Stockholm Declaration on national constitutions, Birnie et al. (2009, p. 275).

[16] On the "greening" of human rights, see Boyle and Redgwell (2021, pp. 302–307).

[17] Draft Global Pact for the Environment, Article 2.

[18] Draft Global Pact for the Environment, Article 4, 5 and 6; Rio Declaration, Principle 15.

and chemical technologies, using energy and substances that produce pollution, waste or environmental risks to habitats and species, must be ecologically sustainable and carried out with a sense of ecological responsibility towards the future.

The prevention principle has a strong formulation in the GPE. The GPE speaks categorically of the "necessary measures" to prevent environmental harm, thus pointing to the idea that the principle of proportionality, although relevant, has a limited capacity to moderate the prevention principle.

Prevention of environmental harm—and the need for preventive measures such as the setting of thresholds, environmental impact assessments or the use of the best available technology (de Sadeleer 2021, pp. 125–132)—always has an economic cost that must be balanced, to a certain extent, with environmental values. Conducting environmental impact assessments, to protect fauna, flora and ecosystems, or adopting the best available technologies in industries and transportation, to avoid pollution, is costly. Sustainable use of natural resources or protection of a habitat by means of a land or marine protected area implies deprivation of immediate economic profits. However, any cost-benefit analysis must be limited when applying the prevention principle because many of the environmental impacts of human activities "are, by their nature, non-monetary or non-quantifiable, at least not in any reasonably accurate way – for example, how much is a human life, an ecosystem, a species, a view of a mountain range, or a national park worth in monetary terms, both now and in the future?" (Magraw and Hawke 2007, p. 636).[19]

The GPE will also expressly consecrate the precautionary principle as a principle of global law (nowadays, the principle is not always recognised, in international and comparative terms, as a binding legal principle). Article 6 of the DGPE determines that "Where there is a risk of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing the adoption of effective and proportionate measures to prevent environmental degradation".[20]

The precautionary principle is rooted in the idea that "today's choices must also reflect a still uncertain future". It "is therefore justified by consideration of the long term" (de Sadeleer 2021, p. 19). Anticipatory measures are justified even in the context of scientific uncertainty or doubt about the future consequences of a certain human action, activity or omission—for instance, the use of a chemical substance, a persistent organic pollutant, an energy source, a genetically modified organism (GMO) or any other biotechnology, as well as the non-adoption of measures to protect a species or a habitat.

The precautionary principle is linked to the emergence of "post-industrial risks", risks that are "more global (ozone depletion, climate change) than local (pollution of the Great Lakes)", risks that "may give rise to damage outside the realm of commerce (e.g., to human health) and thus be impossible to evaluate" and risks that "are permeated with unquantifiable uncertainty" (de Sadeleer 2021, pp. 13 and 273–274). The uncertainty or doubt might relate to the good that is affected (human health, biodiversity, climate) and the seriousness, duration and scale of the damage (de Sadeleer 2021, p. 275). Precautionary measures (banning of substances or technologies, pollution thresholds, best available technology, species protection) are justifiable when there are "grounds for concern", that is, when "it is not unreasonable to anticipate the occurrence" of a risk "on the basis of certain data or hypotheses, even if those data have not yet been fully validated" (de Sadeleer 2021, p. 287). The precautionary principle imposes a burden of proof on potentially damaging economic activities and technologies in favour of environmental protection (*in dubio pro natura).* If the possible environmental harm is serious or irreversible, public authorities do not need conclusive scientific proof of the risks (de Sadeleer

[19] On the difficulty of "costing the earth", Bell et al. (2017, p. 52).

[20] Draft Global Pact for the Environment, Article 6; Rio Declaration, Principle 15.

2021, pp. 335–336) in order to restrict economic or technological activities. It is enough to show that there are "grounds for concern".

The GPE will also explicitly consecrate the principle of intergenerational equity: "Present generations shall ensure that their decisions and actions do not compromise the ability of future generations to meet their own needs".[21] This principle standardises the universal and global duty to take care of the environment and the idea of ecological sustainability, including the sustainable use of natural resources, placing that duty in the context of the long-term horizon of humankind as a whole, including future generations.

The principle of intergenerational equity is linked to the idea of "irreversibility", but also to the idea of "difficult reversibility" at least in the next generation. The notion of intergenerational equity underlies some treaties, such as the 1992 Convention on Biological Diversity and the 1992 Framework Convention on Climate Change, which have "the avoidance of irreversible harm" (Boyle and Redgwell 2021, p. 122) as their main purpose. It also underlies treaties on fish stock conservation, such as the 1995 Agreement on the Conservation of Straddling and Highly Migratory Fish. However, a fundamental legal principle, such as the principle of intergenerational equity, always goes beyond its specific positive implementations.

The basic idea underlying this principle is the following: "if the human beings now alive continue to deplete resources at current rates of depletion, the next generation or generations will face severe shortages [. . .]. If the human beings now alive continue to tolerate the levels and kinds of environmental degradation that became common during industrialization and after it, this will in other ways impoverish future generations" (MacCormick 2011, p. 140). According to the principle, "renewable resources should be used in such a way that they keep the capacity of recovering or growing again; non-renewable resources should be saved; the natural equilibria in their own dynamic should be respected, this is particularly important concerning the climate" (Holzleithner 2009, p. 67); finally, non-recyclable waste, such as plastic waste or nuclear waste, should be minimised or avoided.

This principle is primarily focused on human "needs". However, the concept of "need" does not necessarily mean economic needs, and therefore may be related to the concept of "value", including "value of existence" and "value of option" (Roser 2016, p. 407). In this meaning the "needs of future generations" might include, besides natural resources, not only human rights (Roser 2016, p. 408), such as life, health, food or housing, but also needs satisfied by "the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components", as well as by the "life sustaining systems of the biosphere" (United Nations 1992). Given that the conditions of human life depend on the biosphere and that biodiversity and the whole biosphere have scientific, cultural, recreational and esthetical value, the difference between the protection of future generations and the protection of nature must be heavily played down (Ost 2003, p. 296).

Having seen the preventive and anticipatory approach of ecological responsibility and sustainability presupposed by the DGPE, it is essential to see how the DGPE promotes its own global implementation, namely through a complex strategy carried out by states and other entities that includes not only legal measures but also market mechanisms and scientific research and education.

First of all, states and other entities such as the European Union must approve legal measures in order to prevent environmental damage, losses, and risks, for instance, the classification of land and marine protected areas, fisheries management, banning of coal-produced electricity or setting of carbon emissions thresholds. They must also "encourage" companies and citizens—namely through market mechanisms—to fulfil their duty to take care of the environment, for instance, with green taxes on fossil fuels or plastics, subsidies for renewable energies or

[21] Draft Global Pact for the Environment, Article 4.

ecolabels for sustainable seafood. States and other similar entities, such as the European Union, must also provide access to environmental justice and promote environmental scientific research and education. At the international level, the DGPE provides a non-adversarial and non-punitive implementation mechanism based upon a Committee of experts and obviously presupposes not only international cooperation but also all the legal and institutional means provided by the hundreds of multilateral treaties or agreements directly or indirectly related to environmental protection.

Is the GPE the appropriate framework to unify and systematise the ideal and the reality of a Blue Planet Law, understood as the Global Law of the Earth Ecosystem?

Kotzé and French argue that the GPE should adopt a more ecological and less anthropocentric approach. According to the authors, the word "environment" is linked to the prevailing anthropocentric approach that underlies international law instruments such as the Rio and Stockholm Declarations that "have been unsuccessful in juridically extending greater care to the non-human world". They say the GPE should be named the "Global Pact for the Earth System" or simply the "Global Pact for Earth", invoking the World Charter for Nature's imagery of a "caring Mother Earth" or "nurturing nature" or the Earth Charter's "Earth as our home" (Kotzé and French 2018, p. 819).

It is true that the word environment, including "air, water, soil, flora, fauna, ecosystems, and their interaction" (Boyle and Redgwell 2021, pp. 208–214), gives the idea that these elements are simply something "around" human beings, whereas the word "Earth system" or "caring Mother Earth" would give the idea of something in which human beings are included as an integral part. However, the DGPE assumes, in our opinion, a more strongly ecological approach than traditional environmental law.

In fact, as we have seen, at the centre of the DGPE is not simply the human right to a healthy and sound environment but rather the duty to take care of the environment. And this duty of care towards the environment is established by reference to holist and planetary entities such as "biodiversity", "ocean", "climate", "future generations" and the "Earth's ecosystem".[22] Obviously, we may say that what is ultimately at stake is humankind as a whole, but there is no doubt that the reference to the "Earth's ecosystem" points to the biosphere as a whole, on which human beings—that is, human life, health, food and well-being—depend. The DGPE presupposes "recognition of the interdependence of humanity and the entire natural world", which already underlies the 1992 Conventions on Biological Diversity and Climate Change (Boyle and Redgwell 2021, pp. 8–9), and which is exactly the holistic approach that we must develop with the Blue Planet Law of our economic and technological world.

5 Sustainable Development and the Challenges of a Blue Planet Law

Economic growth, the increase in the production of goods and services, industrialisation, and the global wealth of nations promote human well-being. However, economic growth must be financially and economically sustainable in the long run. Furthermore, economic growth is not an end itself; an increase in GDP per capita is not all that matters.[23] Economic growth must also be socially and environmentally sustainable: it must consider "social development (including human rights)" and "environmental development (including human health)" (Magraw and Hawke 2007, p. 614). In fact, societies must tackle—with a "freedom-oriented perspective"—hunger, poverty and gender inequality, and no one must be deprived of basic goods such as health care or education (Sen 1999, pp. 13–34, 282–290). Moreover, societies and the world community must preserve the biosphere, biological diversity

[22] See the definition of the "holistic approach" in Seelmann and Demko (2019, pp. 266–267).

[23] See Nussbaum (2011, pp. 46–68), speaking of a "necessary counter-theory" against the exclusive "GDP approach".

and ecosystems, as the life support on which human health, food, and well-being depend. In short, sustainable development means long-run sustainable economic growth compatible with social equity and environmental responsibility.

The 2030 Agenda for Sustainable Development, which we have already mentioned, enshrines 17 Sustainable Development Goals (SDGs). Four SDGs are directly and strictly associated with the duty to take care of the environment: sustainable production and consumption patterns (SDG 12), climate action (SDG 13), preservation of life below water (SDG 14) and preservation of life on land (SDG 15). Other SDGs are also more or less connected to environmental protection. It is obvious, for instance, that the development of renewable energies (SDG 7) is decisive in mitigating climate change (although production of these may have other environmental impacts). There are also other less obvious but significant interactions. For instance, gender equality (SDG 5) and the empowerment of women in developing countries would reduce demographic pressure on the planet and thus contribute to mitigating climate change and preventing the destruction of habitats (Sen 2010, p. 249).

Sustainable development is related to international economic law, international law related to social development, especially human rights, and international environmental law (Segger and Khalfan 2006, p. 51). However, it also includes a national legal dimension. The above-mentioned sustainable development goals are related to both international and domestic environmental law. The latter plays an important role in achieving the environment-related sustainable development goals, which, in order to better guide social and economic activities, must assume legal form. Ecological sustainability depends on social, political, and economic behaviour, but also on the establishment of legal rules, principles, and objectives. What do our societies need in order to move towards more robust environmental legal protection in the context of eco-friendly economies and technologies? In other words, what do we need to step into a Blue Planet Law?

First of all, it is important to approve the Global Pact for the Environment (GPE). As we have seen, the GPE would consecrate at UN level the human right to an ecologically sound environment and, especially, the universal duty to take care of the environment. It would also codify and systematise in a single document the core principles of global environmental law. It could "provide a 'toolbox' for the general improvement of international environmental law and the enhanced effectiveness of environmental protection" (Voigt 2019, p. 22). In fact, "a Global Pact would confer rights, obligations and duties [. . .] thus catalysing effective participation and action for environmental protection. A Global Pact could be a guiding compass for all actors in society—citizens, businesses, and states. For citizens and NGO's a Pact would provide new guarantees and strengthen their capacity to assert their environmental rights before national courts. For corporations, a Pact would create a level-playing field and provide more predictability and legal security, which are crucial for making long term investments. For governments, a Pact would provide a basis to create new legislation" (Aguila 2020, p. 9). The GPE will be the centre and the catalyser of the Global Law of the Earth Ecosystem.

Moreover, two important international conventions should be adopted: the treaty of the High Seas (Treaty on Biodiversity Beyond National Jurisdiction), which would complement the UN Convention on the Law of the Sea, and a Global Agreement on Biodiversity Protection, as an additional supplement to the Convention on Biological Diversity (UN Environment Program 2021, p. 6) . It is also vital that the targets of the Paris Agreement are taken seriously by states, and especially by the most developed or populated countries.

However, the main effort must be made at a national level or at the level of supranational entities such as the European Union. States establish by law environmental standards concerning CO_2 emissions or the use of pesticides; they organise the spatial planning of their territory and classify land and marine protected areas; they regulate eco-friendly market mechanisms such

as green taxes, subsidies or ecolabels (Segger and Khalfan 2006, pp. 89–90). All this must have an international and global framework, but its effectiveness is always heavily dependent on the states themselves.

The law of the Anthropocene must promote eco-friendly economies and eco-friendly technologies.[24] It is true that nature has its own mechanisms. For instance, no technology is as efficient as the forests and a healthy ocean in sinking CO^2 and mitigating climate change, and, generally, the best way to protect an animal or vegetal species is simply to protect or preserve its habitat. However, economic and technological development will not stop, and the world obviously does not want to return to the pre-industrial age. Therefore, economic and technological developments have to acquire a new direction: we need ecologically sustainable policies, economies and technologies. And we need sustainable development informed by a holistic, intergenerational and precautionary approach (Magraw and Hawke 2007, pp. 628–632).

6 Conclusion

Ecological responsibility and sustainability are as urgent in the twenty-first century as individual rights and freedoms were in the second half of the twentieth century. If, as we believe, there are universal legal values, they are no longer represented only by human rights. Human Rights Law must be complemented by an Earth Ecosystem Law, a Blue Planet Law.

Blue Planet law is, as we have said, the law of a humanised biosphere, and it is more or less equivalent to what Kotzé designates the "Earth System Law" (Kotzé 2019). Nevertheless, our approach is a little different, since we believe that we cannot completely abandon a human-centric approach and, therefore, we are more optimistic regarding the DGPE, believing that it can and will be a keystone towards a Blue Planet Law, the law of the humanised biosphere. Blue Planet Law is the Law of the Earth Ecosystem, of the techno-economic civilisation, that incorporates the just demands of ecological responsibility or sustainability.

The Law of the Anthropocene must be based on a universal duty to take care of the environment that is not synonymous with a human right to a healthy environment. This new law has a new object: the humanised biosphere, the Earth Ecosystem composed of the atmosphere, water, soil, fauna, flora, and all this together in a complex network of interactions with humans. The Law of the Anthropocene must not forget that humans are economic and technological beings (*homo economicus*, *homo faber*), but must assume the equilibrium of humankind and nature as a supreme international, political and legal goal.

We need a Blue Planet Law, an Earth Ecosystem Law. This Blue Planet Law is, as we have said, beyond Human Rights Law. It has a different object. Its object is not to protect persons, as individuals, as free and equal beings; it aims rather to protect humankind, the common good and the biosphere. It supposes a holistic approach according to which we must protect not only individual human and non-human living beings, but also holistic entities such as humankind, species, ecosystems and the biosphere as a whole.

[24] Andressen and Skjaerseth (2008, p. 183): "the development of environment-friendly technology represents an important part of the solution to many environmental problems".

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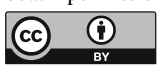

Environmental Law in the EU: A Pathway Toward the Green Transition

Nicolas de Sadeleer

Abstract

Thanks to EU environmental law, much has been achieved over the last 40 years. EU Treaties mirror this success and the importance afforded to environmental protection. The European Union's goals are not solely economic, but also environmental. Furthermore, the proper functioning of the internal market must be accommodated with a flurry of non-market values, among which is environmental protection, the legal protection of which is also essential. Recently, the EU ambition to achieve, on its own, climate neutrality by 2050 is prompting a major legislative reform ranging from energy transition to ecosystem restoration. The emphasis is placed on a 'net-gain principle' underpinning a 'regenerative growth model' substituting the no net loss model that is insufficient to cope with the growing environmental pressures. What is more, the EU aims to reduce its global footprint. Last, the 672.5 billion euros to be invested by the 27 Member States under the Resilience Recovery Facility, which is to guarantee the economic, social and environmental resilience of the Member States, must be allocated to reforms and investments related to the green transition.

Keywords

Sustainable development · Environmental integration clause · Environmental policy objectives · Environmental principles · EU Green Pact

1 Introduction

Although not mentioned in the 1957 Treaty of Rome, environmental concerns have, through various Treaty reforms, gradually been able to establish themselves as one of the primary values enshrined in the EU Treaties. With the entry into force of the Treaty of Lisbon on 1 December 2009, environmental issues are not only cutting across traditional boundaries of 'official' disciplines, but are also entangled with other tradable as well as non-tradable interests. Henceforth, environmental protection is not only a core objective of the Union but has also been placed on an equal footing with economic growth and the internal market.

The first section of this chapter seeks to highlight the real teeth of the particularly far-reaching provisions of the Treaty on European Union (TEU), the Treaty on the Functioning of the European Union (TFEU), and the Charter of Fundamental Rights (EUCFR) enshrining cross-cutting concepts that are likely to enhance environmental values. Section 2 addresses the green transition and the manner in which it is fleshing

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out the integration principle. Lastly, Sect. 3 discusses how 37% of the 672.5 billion euros of the European Recovery and Resilience Facility allocated to the 27 Member States will be subject to climate and environmental conditionality, given the requirement that national investments should cause no "significant harm to environmental objectives".

2 The EU Constitutional Environmental Framework

In this first section, we shall comment on the key obligations of the TEU and TFEU provisions referring to the environment (De Sadeleer 2014, pp. 4–93; Sikora 2020). Particular attention will be paid to the concept of sustainable development, the integration clause, and the obligation to achieve a high level of protection. As will be seen, these obligations are to a great extent intertwined.

2.1 Sustainable Development

At the outset, the concept of sustainable development was forged in an attempt to reconcile development needs with environmental protection. Given the current challenges related to energy production and consumption, climate change, biodiversity loss, illegal immigration prompted by natural disasters and the limited amount of heavily exploited natural resources, the importance of sustainable development is even more obvious today than when the concept was forged at the end of the 1980s.

With the entry into force of the Treaty of Lisbon, sustainable development was subsequently recognised as one of the main objectives to be pursued by the EU. The concept is currently enshrined in Article 3(3) to (5) TEU, Article 21(2)(d) to (f) TEU, Article 11 TFEU and Article 37 of the Charter of Fundamental Rights of the EU.

The third paragraph of Article 3 TEU reads as follows: "The Union … shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment. It shall promote scientific and technological advance". Since it is made up of three heads (social, environmental and economic), sustainable development in EU law represents a delicate balancing of competing social, economic and environmental interests. From the perspective of sustainable development, the concept of the environment has, in addition to its core elements, an economic dimension as well as a social dimension.

Moreover, pursuant to paragraph 5 of the above provision and also Article 21(2)(d) TEU, sustainable development is one of the cornerstones of EU external policy.

In addition, sustainable development is also encapsulated in Article 11 TFEU and Article 37 of the Charter of Fundamental Rights of the EU, without however being defined. Under these two provisions, sustainable development is set out as the objective to be pursued by the EU's environmental policy. Article 11 TFEU provides that: "Environmental protection requirements must be integrated into the definition and implementation of the Union policies and activities, in particular with a view to promoting sustainable development". Similarly, Article 37 of the Charter lays down that "a high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development".

In view of Article 3(3) TEU, sustainable development, and hence the objective of environmental protection, cannot be dissociated from other policies, and in particular the internal market. Indeed, paragraph 3 of the provision places these objectives on an equal footing. Consequently, they must be analysed more in terms of reconciliation rather than opposition. Moreover, environmental concerns are not isolated; they overlap with other policies that were originally regarded as ancillary to or liable to counter the goals of economic integration. In particular, policies relating to the consumer, health and the

environment share a range of common features, so much so that one may speak of a cross-fertilisation between them.

2.2 Environmental Integration Clause

Environmental protection has often given way to socioeconomic considerations. For instance, in cases involving overlap of administrative regulations, the solutions adopted by the EU and national courts have generally leant in favour of economic development rather than the conservation of natural resources. Nature has thus paid a heavy price for the lack of incorporation of environmental requirements into other policies.

As discussed above, one of the key features of sustainable development is precisely the integration of environmental concerns into socioeconomic policies. In other words, curbing unsustainable trends requires the integration of environmental requirements across policies such as energy, agriculture and fisheries, forestry, industry, transport, regional development, land use, and land planning. Unless this is achieved, environmental degradation will continue apace.

As far as EU law is concerned, in addition to recognising sustainable development, it was also indispensable to provide for different policies to be decompartmentalised in line with environmental considerations. Against this background, a number of treaty provisions require the integration of environmental concerns.

Firstly, by virtue of Article 13 and 21(3) TEU and Article 7 TFEU, the Union ensures consistency of all its policies and activities. Secondly, Article 11 TFEU and Article 37 CFREU require environmental protection requirements to be integrated into the Union's policies and activities, in particular with a view to promoting sustainable development.

2.3 The EU Environmental Policy

Entirely devoted to the environment, Title XX of the TFEU does not limit itself to confirming the EU's competence in environmental matters; it also sets out objectives, states principles, and establishes criteria.

In line with Article 3 TEU, the EU aims "to promote . . .the well-being of its peoples" and, in particular, "a high level of protection and improvement of the quality of the environment".

With regard to environmental policy, the competence is defined in terms of objectives to be achieved, rather than areas of activities to be regulated. Indeed, pursuant to Article 191(1) TFEU, the environmental policy pursues four objectives:

- preserving, protecting and improving the quality of the environment,
- protecting human health,
- prudent and rational utilisation of natural resources,
- promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.

These objectives have proved to be particularly far-reaching, especially when compared with those of the transport policy. They play a key role in justifying Article 192 TFEU as the legal basis for a swath of environmental measures. Given the extremely general and fluid nature of these four objectives, the EU lawmaker is left with a genuine discretionary power as to the fundamental choices of this policy. In *Peralta*, the Court of Justice ruled that former Article 130r (Article 191(1) TFEU) "confines itself to defining the general objectives of the Community in environmental matters." "Responsibility for deciding what action is to be taken" in order to achieve these goals is conferred on the lawmaker by [Article 192 TFEU].[1] Consequently, the priority areas for action are likely to change regularly in accordance with political willingness to ward off environmental risks. Given that the powers to act in environmental matters are so broad, the EU environmental competence encompasses almost any environmental measure: biodiversity, water, soils,

[1] Case C-379/92 *Peralta* [1994] ECR I-3454, para. 57.

air, climate, hazardous substances, waste, oil spills, product life-cycle analysis, pesticides, listed installations, noise, impact assessments, procedural rights such as access to information and justice, etc. It thus proves difficult to draw the limits of this protean policy.

The environmental policy is the only EU policy to proclaim a cluster of principles. Article 191(2) TFEU is worded as follows:

> Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.

Given that most of these five principles were already embodied in international environmental agreements, they did not take root in virgin soil. For instance, prevention and precaution straddle both international and EU law. Even though there are various definitions of these five principles in international environmental law, these five principles have not been defined by the Treaty framers. It is well known that the adoption of environmental measures owes more to political compromise than to tidy application of constitutional principles. However, this does not mean that the principles enshrined in the TFEU are devoid of legal effects. On the contrary, in contrast to other rules of indeterminate content, these five principles are mandatory (De Sadeleer 2020, pp. 449–494). Furthermore, the Article 192-(2) principles also apply to national authorities, if the latter are obliged to implement EU directives that encapsulate one or more of these principles (De Sadeleer 2020).

These five principles, in fact, have a guiding, oriented role, rather than merely a theoretical or political role. On one hand, they enrich the formulation and implementation of environmental law. They can be invoked by the EU institutions as a justification for adopting stringent regulatory regimes. Conversely, the Member States can also use them to derogate from the free movement of goods. On the other hand, by more clearly defining the limits within which public administrations exercise their discretionary powers, they provide the former with a more coherent orientation and consequently legitimise their actions. Lastly, by freeing courts from the constraints of an overly literal interpretation of texts, they also have an interpretative function.

Pursuant to Article 3(3) TEU, 191(2) TFEU and Article 37 CFREU, EU policies shall aim at attaining a high level of environmental protection.[2] Measures related to the establishment of environmental protection and the obligation to attain a high level play a key role in carving out an environmental general interest. In effect, restrictions placed on basic rights, such as property or economic activities, with a view to protecting the environment can be justified provided, on one hand, that those restrictions correspond to objectives of general interest and, on the other hand, that they do not constitute an intolerable interference impairing the very substance of the rights guaranteed. Measures impairing fundamental freedoms might be justified in the light of this obligation. The conservation of biodiversity,[3] waste management,[4] water protection,[5] and prevention of climate change[6] have thus been recognised by the Court of Justice as pursuing an objective of general interest restricting basic rights.

In sharp contrast to the above obligations, the four requirements set out in Article 191(3) TFEU play an ancillary role.

Lastly, one has to bear in mind that the EU has no exclusive competence for protecting the environment. Pursuant to Article 4(2)(e) TFEU, the environment has been classified among the eleven shared competences, alongside the internal market, consumer protection, and transport.

[2] Unlike the prevention or the precautionary principles, none of these provisions proclaim as such a 'principle' of a high level of environmental protection. That said, the EU courts and several commentators have classified this obligation as a principle.

[3] Case C-67/97 *Bluhme* [1998] ECR I-8053, para. 33.

[4] Case C-302/86 *Commission v Denmark* [1988] ECR I-4607, para. 9.

[5] Case C-293/97 *Standley* [1999] ECR I-2603, para. 54.

[6] Case C-379/98 *Preussen Elektra* [2001] ECR I-2099, para. 54.

Accordingly, in the light of Article 2(2) TFEU, the EU has the power to legislate and to adopt legally binding acts in the environmental area. Both the EU and Member States may act in order to protect the environment. However, Member States exercise their competence inasmuch as the EU has not exercised its own competence. Since environmental policy is not vested exclusively in the EU, the principle of subsidiarity enshrined in Article 5(3) TEU applies. In particular, the focus is on whether the EU is the most appropriate decision-maker. The EU 'action' must satisfy two tests. First, the EU institutions have to demonstrate that the objectives of the proposed action cannot be sufficiently achieved by the Member States "either at central level or at regional and local level" (sufficiency test). Second, they should also demonstrate that the proposed action by reason of its scale or its effects "can be better achieved at Union level". According to this second test, the lawmaker is required to demonstrate that the proposed action has an added value in terms of effectiveness (value-added test).

3 The EU Green Pact: A Silent Revolution?

3.1 Introductory Remarks

Whether it is its stuttering growth, its flagging demography, its timid foreign policy or its timid technological innovation, Europe is showing signs of weakness. Failing to assume political and military leadership, the EU is trying to strengthen its credibility by positioning itself at the forefront of the green transition, which should significantly modify our production and consumption patterns. According to the European Commission, "We are at a crucial moment in the global response to climate and biodiversity-related emergencies, and we are the last generation that can still act in time" (European Commission 2021a).

In this context, the European Commission adopted two landmark communications, in 2019 and 2021. The first of these two communications, the European Green Deal adopted by the Commission in December 2019, sets out the blueprint for this transformational change (European Commission 2019; Krämer 2020). The Commission analyses the development of policies for clean energy supply across the economy, industry, production and consumption, large-scale infrastructure, transport, food and agriculture, construction, taxation and social benefits. Furthermore, it foresees the adoption of a swath of strategies on biodiversity, the circular economy, zero pollution, sustainable and smart mobility, sustainable food, hydrogen, batteries, marine renewable energy and many others.

Under European climate legislation (Regulation (EU) 2021/1119), the EU has set ambitious targets to reduce net emissions by at least 55% by 2030 compared to 1990, as well as to be the first climate-neutral continent by 2050. In this context, a new communication, the 'Fit for 55' package, sets forth a number of legislative proposals, which aim to enable the European Union to reach this 55% reduction by 2030 and thus achieve climate neutrality by 2050. In other words, these proposals are interconnected and oriented towards the same objective of ensuring a just, competitive and green transition by 2030 and beyond.

Against this background, the Commission is in the process of submitting to the EU lawmaker 12 legislative proposals (Fit for 55), several of which are likely to impact trade and investment with third countries. The EGD appears to be significantly more ambitious than previous EU environmental programmes for the following reasons:

- the sheer breadth of the green transition given that it ranges from the energy transition to the restoration of ecosystems,
- the speed with which the green transition is unfolding given that a reduction of 55% of GHG emissions must be achieved by 2030,
- the binding nature of the legislative acts (directives and regulations) that flesh out the non-binding Commission's Strategies,

- the emphasis placed on a 'net-gain principle' underpinning a 'regenerative growth model'[7] substituting the no net loss model[8] that is insufficient to cope with the growing environmental pressures the EU is facing,
- the complementarity of the internal and external action in order to reduce the EU's footprint.

3.2 The Background to the Green Transition

The green transition responds to political, economic and security needs. First of all, Europe has always been at the forefront of the promotion of universal values, such as democracy, the rule of law and fundamental rights,[9] which could be shaken by the scale of the climate crisis. As a strong defender of these values, the EU must assume global leadership by encouraging third countries to pursue the same level of ambition.

Secondly, as Europe does not have sufficient fossil fuels and mineral resources to ensure its growth, it has every interest in becoming self-sufficient[10] in a world where resources, particularly raw materials (such as Antimony, Heavy Rare Earth Elements, Scandium, Silicon metal, etc.), are becoming increasingly scarce (See, among others, European Commission 2011). This self-sufficiency can be achieved by resorting to renewable energies and promoting a circular economy where everything is recycled. Forced to innovate, European companies will become more competitive whereas their foreign competitors will eventually fall victim to the poor management of natural resources by their national authorities.

Thirdly, in terms of security, the European continent is surrounded by regions facing recurrent instability that could be exacerbated by climate change and diminishing water resources. Victims of drought and famine, entire populations form the Sahel and the Middle East could seek refuge in the European Eldorado and be stranded on the shores of Fortress Europe.

While it is one thing for the EU institutions to proclaim ambitious goals, it is quite another to determine the means to achieve them. Once again, the devil lies in the regulatory detail. In addition to a flurry of legislative proposals, the financial and social dimensions of the green transition also play a key role in achieving this paradigmatic change. Indeed, it will take more than a stick to make the donkey move. Also, without public and private investment, the new standards will not have the desired effect. The 672.5 billion euros foreseen by the Resilience Recovery Facility, which is to guarantee the economic, social and environmental resilience of the Member States, must be allocated to reforms and investments related to the green transition (Article 19(3) e) of European Union 2021a). As public investment will be insufficient to achieve climate neutrality by 2050, since the taxonomy regulation of 2020 (European Union 2020) the private sector has been encouraged to invest in economic activities classified as sustainable. This has met the expectations of the market, which issued €278 billion in green bonds in the EU in 2019. Intergenerational solidarity in the face of the climate challenge requires other types of financial solidarity between States (Just Transition Facility of €55 billion) but also between citizens (Just Transition Fund of €17.5 billion).

[7] Biodiversity Strategy 2030, Circular Economy Action Plan.

[8] UN 2000 7th Millennium Development Goal, UN 2010 Aichi Targets, 2015 Sustainable Development Goals.

[9] In particular, the rights to life and to family life (Articles 2 and 8 of the European Convention on Human Rights (hereafter ECHR) are likely to be jeopardised by rises in sea level. In the landmark *Urgenda* case, the Dutch Supreme Court held that, given the severity of the impact of climate change, the Dutch State is subject to a duty of care in accordance with Articles 2 (right to life) and 8 (right to privacy and family life) ECHR, which have direct effect, and is required to adopt mitigating measures. Accordingly, an over-cautious policy for reducing GHG emissions breaches Articles 2 and 8 ECHR. Case C-19/0035, *Urgenda* [2019] HR: 2019: 2006.

[10] As set out in its 2020 Industrial Strategy, the EU further aims to improve its open strategic autonomy in key areas. See European Commission (2020b).

3.3 The Legal Conundrum

The legislative reforms envisaged by the European Commission appear, at first sight, to be very ambitious. However, this silent revolution will not happen overnight. As a starting point for this reform, the 2019 Green Deal was progressively refined in 2021 by the 'Fit for 55' package and a host of strategies, from forest management (European Commission 2021b) to pollution abatement (European Commission 2021c). The ambitious objectives announced in these 'soft law' acts need to be fleshed out into binding secondary legislation.

The success of the European green transition is therefore dependent on a complex normative process where directives and regulations intertwine in a flurry of public policies, subject to variable competences (exclusive, shared, etc.), involving institutions with divergent, if not antagonistic, interests. With the adoption of the European climate law in June 2021, a first step was taken (European Union 2021b; Misonne and Peeters 2022).

It has always been a tall order to specify with exactitude the division of competence between the EU and the Member States. Given the cross-cutting nature of environmental issues, the exercise of competences relating to these has been dogged with controversies. In fact, the allocation of competence between the EU and the Member States tends to be not so much a separation but rather an intermingling of powers. Given that the EU environmental policy also embraces health issues, the management of natural resources and territorial management, and to some extent worker protection, other areas classified as shared competences are likely to interact with the environmental policy. Accordingly, their relationship is more dynamic than static. Several axes of the legislative reform emerge:

- maximum integration in the framework of the internal market (Article 114 TFEU),
- minimum integration in the case of the environmental policy (Article 192(1) TFEU),
- tax harmonisation (Article 113 TFEU) (European Union 2003a),
- minimum integration in the case of the energy policy (Article 194(1) TFEU).[11]

We provide here but a few illustrations of the legislative changes envisaged by the European Commission.

The 'Fit for 55' package (European Commission 2021a) includes four proposals promoting cleaner vehicles and fuels through new product standards (See, among others, European Union 2019). All these measures are mutually reinforcing and complementary. In addition, the Commission also proposes promotion of the use of sustainable fuels in the aviation and maritime sectors as a complement to the Emissions Trading Scheme (ETS) for both sectors. These harmonisation measures are based on Article 114 TFEU (European Union 2019). With the aim of greening transport and reducing sector GHG-emissions by 90% by 2050, the Commission pledges to ban subsidies and increase prices for fossil fuels, which falls within Member States' competences.

The modifications of the EU's common framework for energy taxation—the Energy Taxation Directive, which lays down structural rules and minimum excise duty rates for the taxation of energy products used as motor fuel and heating fuel, and electricity (European Union 2003a)—should complement other initiatives in the EU's 'Fit for 55' package by ensuring that the taxation of motor and heating fuels and electricity in the EU reflects their environmental impact. The Commission envisages banning the current tax exemptions, including for aviation and maritime fuels.

The European Commission proposes a revision of the rules of the aviation emissions trading scheme (European Union 2003b), also based on Article 192(1) TFEU, as part of the 'Fit for 55' legislative package, to ensure that the sector contributes to the more ambitious target of achieving a net emissions reduction of at least 55% by 2030, compared to 1990 levels. Free

[11] For instance, the Governance Regulation has been adopted in both Article 192(1) and Article 194(1) TFEU. See European Union (2018b).

allowances allocated to airlines would be reduced over time.

One of the other elements of the 'Fit for 55' package is a revision of the Renewable Energy Directive (RED II) (European Union 2018a) to meet the new 55% GHG target. Under RED II, Member States are currently obliged to ensure that at least 32% of their energy consumption comes from renewable energy sources by 2030. The revised RED II sets a new EU target of a minimum 40% share of renewable energy sources in final energy consumption by 2030. The RED II Directive is also based on Article 192(1) TFEU.

In addition, the European Commission wants to foster a 'renovation wave' of public and private buildings, enforce legislation related to the energy performance of buildings (European Union 2010) and review the Union's standards on construction products.

Similarly, the adoption of the New Circular Economy Action Plan (European Commission 2020c) will lead to the amendment of a large number of waste directives, most of which were adopted on the basis of Article 192 (1) TFEU (De Sadeleer 2017, p. 714). With a view to fostering resource efficiency and climate neutrality in industrial production chains, the Commission is intent upon doubling the recycling rate by 2030 and enhancing sustainable product design, reuse and recycling with a particular focus on resource-intensive sectors such as textiles, construction, electronics and plastics.

Regarding pollution, in 2021 the Commission adopted a zero pollution action plan for air, water and soil. The plan aims to reduce pollution from urban runoff and particularly harmful sources such as micro-plastics and pharmaceuticals.

However, responses to the climate crisis require more than the adoption of product or waste management standards in the internal market. More is needed. Indeed, the simultaneous climate and biodiversity crises cannot be dealt with separately. Restoring nature and allowing biodiversity to thrive again is essential in order for more carbon to be absorbed and stored (European Commission 2021a). Hence, the European Commission is also considering amending several environmental directives that were adopted on the basis of Article 192 of the TFEU. In this context, the Commission wants to increase the capacity of EU forests, soils, wetlands and peatlands, oceans and water bodies to act as carbon sinks. With respect to the Regulation on land use, land-use change and forestry (LULUCF), based on Article 192(1) TFEU (European Union 2018b), the Commission proposes setting higher ambitions for the expansion of the EU's natural carbon sink, which is essential to balance emissions and achieve climate neutrality by 2050.

In its Biodiversity Strategy (European Commission 2020d), the Commission proposes quantified targets, such as increasing the coverage of terrestrial and marine protected areas that are part of the Natura 2000 network established under Directive 92/43 on the conservation of natural habitats and of wild fauna and flora (European Union 1992).

The EU could thus become the first international organisation to achieve climate neutrality by 2050, to replace a linear economy with a circular economy that relies upon fewer natural resources, to halt the erosion of biodiversity, to eradicate pollution, to mitigate the ravages of intensive agriculture, and to reforest massively.[12]

3.4 A Path Strewn with Pitfalls

That being said, the green transition and climate neutrality could fail on more than one count. While the implementation of the Green Deal should strengthen the centripetal forces (adoption of uniform product standards and harmonisation of energy standards), many parts of the subsequent strategies, such as sustainable mobility, agriculture, nature protection, pollution abatement, etc., depend on the goodwill of the Member States, for the simple reason that these areas are not or are only partially harmonised. It will therefore be necessary for the EU institutions to entice the 27 Member States to adopt ambitious

[12] In its New EU Forest Strategy for 2030, the European Commission envisages the planting of 3 billion trees.

environmental protection programmes in order to move forward.

While the harmonisation process is the hallmark of European integration, by setting ambitious objectives through soft law instruments (communications) that bind neither the Member States nor economic operators, the European Commission tends to be incantatory. Political will must be anchored in EU secondary law. Thus, the challenge for the Commission is to flesh out these numerous soft law proposals into legislative proposals to be adopted by the European Parliament and the Council. If this is not the case, the gap between the States willing to implement the green transition and those who doubt its virtues, such as Poland, could widen.[13]

In a globalised economy, the imposition of new standards has the effect of increasing the burden on European undertakings, which are competing with economic operators who are not obliged to integrate negative externalities into the price of their products and services (De Sadeleer 2020, pp. 4–92). The European Commission would like to put an end to this distorted competition. The import of a range of products produced by carbon-intensive industries (nickel, steel, fertilisers, cement, etc.) into the EU would be subject to certificates the value of which would be equivalent to that of the greenhouse gas emission quotas that 12,000 European companies must acquire annually (European Commission 2021d). This border adjustment aims to reduce the risk of carbon leakage. This would ensure that the price of imports of goods subject to CBAM more accurately reflects their carbon content. Here too, the problem lies in the fact that third countries are opposing CBAM on the grounds that this new scheme would amount to a protectionist measure that breaches several fundamental principles of the WTO.

Moreover, the willingness of the European Commission to reform is a last-minute political compromise, as Mrs von der Leyen had to present this programme in order to convince a majority of MEPs to support her candidacy for the Presidency of the European Commission. After seven decades of proclaiming the creed of unbridled productivism, are the senior officials of her institution convinced of the need to change the traditional economic paradigm? So the departure from a business-as-usual approach requires a profound change in administrative culture.

Finally, the path taken by the European lawmaker is strewn with pitfalls. One should bear in mind that the measures adopted by the Union to promote renewable energies, such as support for first-generation biofuels (WTO 2021), have undoubtedly done more harm than good. Moreover, the incentive price of the carbon market has only recently emerged, and this market still does not apply to transcontinental flights.[14] But more fundamentally, the green transition advocated by the European Commission is based on the postulate of decoupling negative externalities from economic growth,[15] which is not called into question, whereas the environmental crisis is partly due to the overconsumption of goods and services.

The implementation of the Green Pact commitments should certainly enable the EU to improve its image, which has no doubt been tarnished by the pandemic crisis.

3.5 The Geopolitics of the Green Transition

Whereas the EU lags behind in research and technological development, including robotics and artificial intelligence, and risks becoming dependent on the US or China, some of its more advanced policies, such as CBAM or the extension of the ETS to aviation, pose pressures for EU companies competing abroad (Damjanovic and De Sadeleer 2020).

[13] Poland has challenged several climate change and environmental directives before the CJEU. See Case T-370/11, *Poland v European Commission* (2013) EU:T:2013:113.

[14] In spite of a favourable judgment handed down by the CJEU in ATAA. See Case C-366/10 *ATAA* (2011) EU:C:2011:864.

[15] Between 1990 and 2018, the EU reduced greenhouse gas emissions by 23%, while the economy grew by 61%.

In addition, a central feature of EU environmental law is its multi-level character. Even if EU environmental policy were to succeed in reducing pollution in the EU, the European environment would still suffer from polluting sources located outside its Member State territories. Conversely, to fuel its economic development, the EU is becoming increasingly dependent on imports of natural resources. It follows that environmental problems associated with the extraction and processing of many materials and natural resources are shifting from the EU to the respective exporting countries. Thus, the EU cannot conduct its environmental policy in isolation.

The global challenges of climate change and environmental degradation require a global response. The EU is playing a key role in the implementation of the Paris Agreement as well as a number of other environmental multilateral agreements. In promoting ambitious internal environment, climate and energy policies, the EU will impact third countries. In this regard, the European Commission envisages a stronger 'green deal diplomacy' focused on convincing and supporting others to take on their share of promoting more sustainable development. Apart from providing the revenue for internal reforms, the EU's green-digital recovery model provides much-needed financial support for the EU's geopolitical appetites and presents an opportunity for a paradigmatic shift in the global economy towards sustainable development. The new recovery facility (RRF) thus enables the EU to align the internal reforms with the achievement of Europe's geopolitical goals.

4 Avoiding Significant Harm to Environmental Objectives

The Green Deal aims to put sustainability at the heart of the EU budget,[16] given that it should contribute to achieving climate objectives. In this connection, the Commission has proposed a 25% target for climate mainstreaming across all EU programmes.

The Covid 19 crisis is having deep economic effects. EU GDP has contracted by around 7.5% this year, far deeper than during the global financial crisis in 2009, while the EU unemployment rate rose to 9% in 2020, adding to the risk of rising poverty and inequality (European Commission 2020a). Although the pandemic has hit all countries, its impact differs considerably between Member States. As a result, some are much more in need of financial support than others. The EU has acted rapidly to deliver a coordinated and powerful collective response to the social and economic consequences of the crisis.

€672.5 billion—about 90% of the European Commission's borrowing—will be allocated to the European Recovery and Resilience Facility (RRF). This amount is broken down into grants (€312.5 billion) and loans (€360 billion) to Member States (Article 6 of European Union 2021a). 70% of the grants for national recovery programmes will be allocated in 2021–22, while the remaining 30% will be allocated in 2023.[17]

Among the six pillars on which the facility is based, the 'green transition' occupies first place.[18] On the climate-environment side, two sub-objectives are pursued: on the one hand, the green transition and, on the other hand, the achievement of the climate objectives. The green transition should be supported by reforms and investments in green technologies and capacities, including biodiversity, energy efficiency, building renovation and the circular economy.[19]

Given that the climate and environmental objectives are at the heart of the European Commission's Green Pact, the Climate Law and subsequent legislative proposals, it was essential that these 672.5 billion euros in grants and loans should be subject to climate and environmental conditions. The recovery and resilience facility (RRF) breaks new ground in that the

[16] Although an economic giant, the EU is in effect a fiscal dwarf. In comparison, the French budget amounts to 7% of its national GDP, while the EU budget is only 1.24% of the GDP of the 27 Member States.

[17] Article 12 RFF Regulation.

[18] Article 3 RFF Regulation.

[19] Preamble RFF Regulation, 11.

socioeconomic assessments specific to the European Semester are now supplemented by an environmental assessment.

The RRF regulation, which is the main instrument to allocate money to the Member States under the Next Generation EU Recovery Package, includes not only a substantial contribution to environmental objectives, but also a requirement that an activity "does not harm" any of the environmental objectives (DNHS principle). Accordingly, Article 17(1) of the taxonomy Regulation 2020/852[20] provides detailed criteria in relation to each of the environmental objectives to ascertain whether a particular economic activity may be considered to cause significant harm to those objectives.[21]

On the other hand, while 30% of the EU budgetary expenditure should be devoted to supporting climate objectives, at least 37% of national measures supported by the Facility should be investments and reforms that support climate objectives.

To conclude, the draft plans are thus to be assessed by the European Commission against two criteria, one negative and one positive. This requirement is unprecedented, as for the first time in its history, a significant part of the EU budget is now subject to environmental conditionality.[22] Accordingly, eligibility for a payment from the RRF is conditional on compliance with climate and environmental horizontal requirements that are different from and additional to the requirements directly established by the fund from which the payment is made.[23]

Each national measure implementing the recovery plan must in any case be subject to such an assessment. None of them should cause "significant harm to environmental objectives".[24] Moreover, Member States must provide an individual assessment for each measure of each part of their plan. However, for national measures that would fully support the six environmental objectives, a simplified assessment is possible.

The designation of the departments within the European Commission responsible for the assessment is a matter for the internal organisation of this institution. However, this choice is crucial. It is to be feared that the officials of the DG in charge of cohesion policy will take less interest in environmental aspects than the officials of the DG for Environment.

The European Commission cannot demand that a Member State invest more in biodiversity or in the circular economy. It should, in our view, only check that the positive and negative aspects of the DNHS principle have been respected.

The RRF does not address the consequences of a negative assessment by the European Commission of a measure on the grounds that it would be contrary to the DNHS principle. Should such incompatibility lead the European Commission to reject the plan as a whole?

The arrangements put in place to enforce the DNHS principle reinforce, on the one hand, state choices and, on the other hand, the Commission's discretionary power, which is practically free of any external control.

5 Conclusions

The Union's goals are no longer solely economic, but also environmental. Furthermore, the proper functioning of the internal market must be

[20] European Union (2020). This regulation aims at providing clarity to the market with respect to the classification of an investment as 'sustainable'.

[21] Article 19 (3), d) RFF Regulation.

[22] In the context of shared budget implementation between the Commission and Member States, conditionality mechanisms in the Financial Regulation and other specific EU rules have emerged. In particular, Regulation (EU) No 1307/2013 provides for climate and environmental conditionality for direct payments to farmers under support schemes within the framework of the common agricultural policy (CAP) (Articles 43 to 47 on establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy).

[23] See Opinion of Advocate general M. M. CAMPOS SÁNCHEZ-BORDONA in Case C-156/21, *Hungary v/ European Parliament and Council,* para. 108.

[24] Ibidem.

accommodated with a non-market value, the legal protection of which is also essential. Since qualitative requirements have been laid down, the requirements of integration, a high level of protection and the principles of environmental law are thus more than just simple policy guidelines.

The Green Deal is likely to accelerate sustainable development in the EU with a particular focus on environmental sustainability. Sustainability which has so far been lying at the periphery of EU economic policies, is deemed to be at the heart of the European integration project. Accordingly, the Green Deal relies on a new governance framework, multiple regulatory approaches ranging from soft to hard law, and significant financial and fiscal commitments (Jendrośka et al. 2021).

Sustainable economic growth goes hand in hand with the conservation of national resources for the benefit of future generations, improvements in living standards, protection of workers against industrial nuisances, consumers' awareness of their ecological impact, and biodiversity conservation. From this perspective, environmental protection ultimately provides an incentive for more responsible economic growth.

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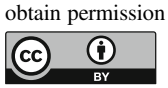

Our Blue Planet at the Crossroads. Between the Hobbesian Nightmare and a New Culture of the Commons

Viriato Soromenho-Marques and Paulo Magalhães

Abstract

The exponential acceleration of the global environmental and climate crisis is becoming an imminent and dangerous existential threat to the sheer survival of humankind. The origins of this unique menacing predicament are deeply rooted in the culture developed in the cradle of European Modernity. It is a culture of utilitarianism, fuelled by an uncritical faith in the unlimited performance of technology in changing the material world. The essence of Modernity was a triumvirate—built upon the congruence between the sovereign State, the techno-science establishment, and the globalised market economy. This power-triangle commodified nature and created a pragmatic and operative fragmentary world culture that brought us to the crossroads we are now entangled in. As a result, International Law does not correctly address the prior theoretical structural problem of the existence of "global commons" that span across borders, or the intergenerational character of the concept of 'humanity'. Global commons have always been understood only as geographical leftover territories outside political borders.

Recognition of the intangible value of the 'software' of the Earth system and legal acknowledgement of a stable climate as a Common Heritage of Humankind will be the *locus* upon which an urgently needed system for management and permanent maintenance can be built, which will be essential to steer the Anthropocene wisely. This new space without enclosed territory should be the new object of global governance, and the seminal concept for a new culture of the global commons.

Keywords

Common concern/Common heritage of humankind · Compulsory cooperation · Earth System (intangible software) · Global environmental and climate crisis · Sovereignty · Utopia/Dystopia

1 Introduction

If we ponder on the present state of our planet, taking the past forty years as our period of analysis, we cannot help but be shocked and deeply concerned about the increasingly tragic situation in which humanity finds itself. Tragedy is used here in the strict sense of the term. The awareness that we have today of the unity and interdependence of humanity on this extraordinary planet is

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overshadowed by the threatening approaching of what seems to be an ineluctable fate. This time, unlike in classical Athenian tragedy, this fate, which we can only contemplate but are seemingly powerless to alter, does not stem from an external cause. It is not the whim of the Olympian gods that should be blamed for the increasing degradation of the balanced state of global life-supporting ecosystems. The threat entails the possibility of deeply damaging the biophysical conditions that could provide for the continuation of human history in a regime of civilisational complexity and refinement. This staggering predicament is not the result of blind indifference towards our fate by colossal and overwhelming physical forces. There is no one to blame but ourselves.

2 The Broken Mirror of Our World View

Paradoxically, the ever-growing capacity to accurately monitor the impact of our aggregate action on the Earth System has given us undeniable proof of impotence. On one hand, we are able to project scenarios regarding the ecological entropy installed on Earth, rooted in our current societal model, but, on the other, we are unable to bring about, in a timely, collective and articulate manner, the cultural, political and economic changes that could prevent these negative scenarios from coming true. The causes of this paradoxical asymmetry between knowledge and action, between lucidity and damaging immobility are deeply buried in our modern history. However, what is evident is that the artificially designed operating rules of the international system are on a clear collision course with the software of nature and are totally inadequate to prevent or even mitigate escalation from a critical ecological situation to a possible ontological and societal collapse (IPCC 2021; Patrick 2021).[1]

2.1 What Should We Name Our Malaise?

From as early as the nineteenth century we can find premonitory testimonies to the growing severity of the damage being inflicted on the planet by human action. Among the pioneers, working between the latter part of the eighteenth century and the first half of the nineteenth century we may highlight the scientific endeavours of Alexander von Humboldt (1769–1859) and José Bonifácio de Andrada e Silva (1763–1838), which anticipated the development of today's Earth System Sciences (Soromenho-Marques 2019b; Steffen et al. 2020). [2] Closer to the present, one of the most surprising warnings of these dire negative consequences came in President Dwight Eisenhower's Farewell Address, which also touched on the serious topic of justice between generations (Eisenhower 1961).[3] However, even today we still have a semantic vacillation, which demonstrates that there is no true and effective consensus on the diagnosis of the cultural illness that is devouring our collective chances of having a future worth living. This lack of consensus is reflected in the difficulty in finding response strategies and a legal and institutional framework powerful enough to implement adequate treatment.

Recently the term *climate emergency* has been gaining ground. However, this is a semantically poor concept because it isolates climate change from its context, as if it were a stand-alone crisis rather than an important part of a larger troubled whole. Another name that has often been used is the *energy transition*. In this case the contractionary and simplifying effect is even greater, as this term not only confines the heart of our

[1] The alarming degradation of the Earth System is highlighted in a stark and accurate manner in the latest IPCC Report (2021). On the other hand, the growing asymmetry between the international system (including diplomacy and international law) and the Earth System is almost at breaking point.

[2] Earth System scientists are today the newest and single academic community able to think of our planet as a complex and interdependent whole object.

[3] "As we peer into society's future, we--you and I, and our government - must avoid the impulse to live only for today, plundering, for our own ease and convenience, the precious resources of tomorrow. We cannot mortgage the material assets of our grandchildren without risking the loss also of their political and spiritual heritage. We want democracy to survive for all generations to come, not to become the insolvent phantom of tomorrow".

civilisational distress itself to the field of climate change but also understands it only as an energy policy problem, leaving aside other key dimensions such as changing lifestyles or the accelerated extinction of biodiversity. Other sectoral proposals have originated from scientists and activists committed to biodiversity conservation. The *Half-Earth* project, presented in 2016 by Edward O. Wilson (1929–2021), recognised as the heir to Charles Darwin, also seems far from grasping the complexity of the biophysical natural processes that support life on this planet, and which cannot be reduced to a rigid territorial partition perspective of the planetary whole (Wilson 2016).[4]

Over the last few decades, the term *Anthropocene* (Crutzen and Stoermer 2000) has often been used to describe the opening of a new geological epoch singled out by the structural and lasting impacts of the action of the human species on the Earth. This seems to be closer to an integrated vision of the current dangerous state of the planet, and the term has several advantages: (a) it makes it possible to insert the time of human history into the long temporality of geological and natural history; (b) it identifies the planet in its entirety as the mega-object where changes take place, leaving no domain out, and focuses in particular on a detailed analysis of the impacts of society and the techno-sphere on the Earth System as a whole; (c) the identification of humanity as the driving force of this new geological epoch is at the same time neutral and descriptive, on one hand, and moral and politically responsible, on the other. By making humanity an actor and a potential victim of its own action, this designation of our epoch gains a significant advantage in the political discussion, bringing science and society mutually closer in the search for political solutions that may inspire new and bold public policies.

[4] Despite being a particularly relevant popular science book, E. O. Wilson's work is mainly focused on reducing the loss of habitat, not taking into consideration other threats such as climate change. Unfortunately, he is also mainly concerned with terrestrial ecosystems, leaving little room for the oceans and marine life.

The historical concept of the Anthropocene is not, however, at odds with earlier, equally comprehensive readings of our contemporaneity, which were more oriented towards a descriptive phenomenology of the specific characteristics of the global environmental crisis. This proposal is validated by the meaning of each of its elements, but what is truly unique is the reciprocal interaction between all the elements: each one acts on all the others, each in turn being affected by all the others.

If we consider our present time as the crossroads of the first human-made *global environmental and climate crisis*, we also place the emphasis on its six main features, summarised as follows:

- Planetary dimension (there is no sanctuary away from this crisis).
- Irreversibility and entropy (e.g., massive biodiversity extinction).
- Cumulative acceleration (e.g., GHGs causing climate change).
- Growing political, social and cultural unrest (e.g., decline of classical power of the State, growing waves of environmental refugees).
- Risk of internal and/or international violent armed conflicts (e.g., the Sahel conflicts, the 2011 Arab Spring).
- Clash between entropy and complexity in the realm of Culture (e.g., the "world visions" of Mr. Trump and Mr. Bolsonaro) (Soromenho-Marques 2019a).

Whatever we decide to call our existentially threatened epoch, the truth is that all diagnoses have simultaneously increased their accuracy through the processing of data and consequently highlight the gloomy content of many of the future scenarios. Despite its sober language, the most recent IPCC report is surely the one that most profoundly illustrates the increasing possibility of the environmental crisis being upgraded to a state of collapse, with permanently negative and irreversible consequences for our future as a species. Recently coined concepts such as "Necrocene" or "humanity's plague phase" are being used with increasing frequency in the

tentative screening of the time to come (McBrien 2016; Rees 2020).

2.2 Factors of Blindness: Hiding the Growing Global Ontological Threat

If we follow the insight of the original proposal of the Anthropocene, we know that the birth of the global environmental crisis overlaps with the beginning of the English Industrial Revolution (1750). It is, however, undeniable that the process of environmental degradation, including the historically unprecedented accumulation of greenhouse gases, intensified exponentially in the second half of the twentieth century, after World War II, in the period that should be called the *Great Acceleration* phase of the Anthropocene (Steffen et al. 2007). However, the roots of the key driving forces behind both the increasing impacts of the human material culture on the natural environment and the stubborn ignorance or underestimation of those impacts go back much further. Let us try, in a very condensed way, to identify what we call the *factors of blindness*, responsible both for concealing the growing symptoms of the global environmental crisis and for the lack of understanding of the shared and common nature of their negative long-lasting consequences.

2.2.1 The Utopian Soul of the Modern Techno-Scientific Revolution

With the various revolutions of the Modernity period, which began in the fifteenth century in Europe, and the expansion of planetary geography and the emergence of a new understanding of the nature and role of science, there was a true metamorphosis in the way humanity began to see itself and to rethink and reshape its relationship with the natural world. Not only was there a quantitative change in the essence and uses of science, but a real qualitative change. Science came to be understood as being increasingly entangled with technology. Scientific endeavour was intended to bring theoretical knowledge of the natural world to the brink of an effective transformation of that same natural world through technologies that would limitlessly extend the human dominium over nature. Science (*episteme*) viewed as the intellectual contemplation of the real, which had satisfied the ancient Greeks, became, with the Moderns, a driver in the process of transforming and dominating the world. To serve that purpose, the key ingredient was the intimate unity between science and technology (techno-science). For the Ancients, the search for a future in conformity with the ideal, given by reason, should be the combined work of philosophy, ethics, education and politics. That idealised future (as Plato explains in *The Republic*) is seen essentially as a change in the relationship that human beings have with themselves and with each other collectively in the political realm. Contrary to the Ancients, the Moderns thought that the great leap forward towards a better future should involve changing the relationship of human societies with nature through technology, seen as the embodiment of human knowledge and inventiveness. The new vision of science was driven by a broader purpose of increasing human power over natural forces and processes, implementing applications that could be developed through the use of innovative technology.

In Modernity, technology ceases to be a mere secondary, instrumental and derivative consequence of scientific primacy, instead becoming the very vehicle and purpose of the desirable future, through our increased ability to alter and mobilise nature to suit our needs and even our whims. It is no coincidence that the concept of utopia was invented in this period, namely in 1516, by Thomas More. Thereafter the most influential utopias that followed suit, such as those of Tommaso Campanella and Francis Bacon, have the increasingly predominant presence of techno-science as the anticipation driving force of a desirable future.

We have reached the contemporary period with a fully-fledged technological orientation of the science infrastructure, and also of its planning and operating procedures, in an atmosphere of uncritical optimism, averse to any prudential reserve. The discourse of unlimited scientific progress marginalised dissenting voices and

regarded the growing toll of environmental and social negative impacts as acceptable collateral damage. The utopian drive of techno-science is increasingly escalating towards the opposite world of a dystopian nightmare (European Environment Agency 2001, 2013).[5]

2.2.2 The Commodification of Scientific Knowledge in a Growing Market Society

A second factor of blindness, with widespread and fundamental importance, is the absorption of techno-science into the economic sphere. Techno-science has become a productive force in a marketplace with variable and cyclical geometry, but always tending towards the maximum possible extension. Techno-science has entered into the competitive war for the conquest of market niches. The self-interest of companies with the capacity for technological innovation met with little opposition to the rapid implementation of patents in this field. With no or little environmental impact assessment regulation worthy of the name, companies were able to get round the fragile regulation by public policies, generally in the area of public health. Often, governments themselves became accomplices of these companies in the unrestricted and unconditional race for the conquest of markets, also as a way to affirm political and national supremacy. The replacement of society by the market, as the key historical actor, paved the way for the profound shift from the model of a society with a market at its service, to the opposite model of a market that transformed society and nature into its two chief satellites (Polanyi 2001). The lessons of pristine industrial capitalism, and the later tumultuous events that led to the first liberal globalisation, and to its demise into the thirty violent years of World Wars, Revolution, and Depression (1914–1945), were quickly forgotten, after three decades of welfare policies and mildly regulated capitalism. In the 1970s the wheel of history turned around, setting the world on the vertiginous path of a second (neo)liberal globalisation entailing with it the intensification of all environmental and technological risks that are today part of our daily routine.

No one has expressed more elegantly than Aldo Leopold what was at stake in the surrender of science to the market's absorption logic. For Leopold, scientific knowledge had two faces: in its capacity to shed light on the unknown, to broaden the horizons of our understanding of natural processes, science was a "searchlight"; but insofar as knowledge transformed by technology becomes power, science is also a "sword". Between the demands of the market and the imperatives of national security, even in peacetime, the sciences and scientists have been pushed to maximise efficiency, even at the expense of the light that might illuminate the dangers that were potentially looming ahead. The role of knowledge as a sentinel against risks and threats was therefore marginalised by an Academy also caught by the feverish urge for exponential growth (Leopold 1977).

2.2.3 The Power Triumvirate and Its Fragmented Worldview

The third factor of blindness strikes directly at the heart of international relations, designed according to the Westphalia blueprint. Its intrinsic and stiff mechanical understanding of sovereignty kept international law, geopolitics and diplomacy under the biased *Realpolitik* spell, unable to screen the rapid and dangerous anthropogenic transformation of the planetary software.

In fact, there is a strong congruence between the three driving actors of contemporary civilisation, which were born in the same period of European history, these being modern science, the sovereign State and the capitalist market economy. These three share a very similar internal structure in fundamental aspects. They are united by the quest for growing efficiency in the transformation of the world. Science was moved by its growing marriage with technology and its wonders. The modern State, especially after the Treaty of Westphalia (1648), was propelled by its tenacious attempt to assert the validity of the

[5] Regarding the complex network of non-scientific pressures that are involved in the scientific agenda of research, the following two EEA Reports may be considered as mandatory readings.

modern myths of sovereignty and autonomy. The market economy was fuelled by the axiomatic imperative of the boundless investment, expansion and multiplication of capital. This triple convergence is densified into a triple fragmentation. Science is divided into disciplinary areas, epistemologically differentiated and even distant, united by an operational agenda dictated from outside, be it national security (such as the Manhattan Project which allowed the USA to win the race to produce the atomic bomb) or private business objectives. The State looks at the planet through the lens of the territorial projection of power, completely oblivious to the complex ecological functioning of the Earth System, concerned only with what lies within the sphere of its sovereignty and largely indifferent to everything and everyone lying beyond its borders. The economy, both as theory and practical activity, focuses only on its internal models and instrumental goals, aiming at unlimited growth of production, consumption and profits. What lies beyond it are externalities that can be put aside in the operation of both economic thought and its praxis. The ideal type of business in a "free society" is depicted by Milton Friedman in his classic essay of 1970, which bluntly states that there should be no such thing as "business social responsibility". That task may be assigned to government policies, not to privately owned corporations whose job is to maximise profits for their "stockholders" (Friedman 1970).

The specific transformative activism of the software shared by these three major institutional players makes up for what they lack in prudence and capacity for critical and strategic reflection. Only once, at the height of the Cold War, when the possibility of a limited nuclear conflict was growing on European soil, did an epistemological breakthrough occur that prevented a third world war, sparing the world from the full destructive impact of atomic weapons. The awareness of Mutual Assured Destruction (MAD) was accepted—at least in the final period of the Cold War—by all parties involved. There was no point in continuing a nuclear arms race if, sooner or later, it would precipitate a war in which there would be no winners, only losers. For reasons not entirely clear, the lessons of the Cold War seem to have been completely forgotten. Today we are witnessing a race between States that are engaged in a true Mutual Environmental Destruction (MED) dynamic. Yet unlike what happened after 1985 with nuclear weapons, and despite all the current ecological and human catastrophes (from climate change to biodiversity loss, soil degradation and environmental refugees, for example), nobody has truly dared to map out the full consequences of this entropic process and demand with a strong voice and a resolute stance that this race towards the abyss should be stopped. If we want to rise to the challenge of the global environmental and climate crisis and avoid falling into a Hobbesian scenario of "war of all against all" over the meagre spoils of a devastated planet, we must be able to defeat our own demons. Our main weapon will be the building of a culture of the commons, by organising "compulsory cooperation" in order to face the dangers we all share (Soromenho-Marques 2016).

3 The Imperative of a New Culture of the Commons

3.1 Breaking Free from the Global Deadlock

It is easy to see that governments have a responsibility to protect their own citizens from pollution that affects the right to life, private life, or property.[6] However, within the environmental crisis and climate change context, all the foundational pillars of international law are questioned. A stable climate that is "an intangible natural resource, which spans across and beyond the national territories of States" (Borg 2007) is not only subversive to current legal structures, but

[6] The Social and Economic Rights Action Center and the Center for Economic and Social Rights v Nigeria, ACHPR, Communication 155/196 (2002), §§ 52–53; Lopez Ostra v Spain (1994) 20 EHRR 277; Guerra v Italy (1998) 26 EHRR 357; Fadeyeva v Russia [2005] ECHR 376; Öneryildiz v Turkey [2004] ECHR 657; Taskin v Turkey [2004] ECHR, §§ 113–119; Tatar v Romania [2009] ECHR, § 88.

also entails potentially enormous domino effects across all the institutions of human society. It pervades in every human sphere: it is a human rights issue; it is a trade issue; it is a biodiversity issue; it is a security issue; it is a health issue. It is a huge challenge affecting the very foundations of the survival of civilisation as we know it. To put it another way, climate change—within the wider framework of the global environmental crisis—is too serious a problem to simply be left in the hands of a particular body of the UN, the UNFCCC, as if it were something that could be dealt with in a separate box, detached from the model of civilisation that brought it into being.

Climate, seen as mentioned above, challenges the very foundations of International Law, because its intrinsic nature is hostile to any kind of physical or territorial division, even in a legally abstract way. Although it is legally possible to divide the areas of the oceans and airspace abstractly into distinct zones, it is impossible to perform the same operation (of abstract legal division) with regard to the biogeochemical composition of the oceans and the atmosphere, or the climate system as a whole, given the sheer physical evidence that the fluids they comprise circulate continuously all around the entire planet. These facts of the natural world demand a new way of thinking about the Earth, and challenge the law to find new solutions capable of dealing with this stubborn scientific reality. Addressing the challenge of recognising in legal terms the intangible functioning process of the Earth System as a single whole requires redefinition of the current concept of "global commons", which so far has been exclusively based on a territorial approach. In the near future, hopefully, it will also include the intangible and non-territorial character of the functioning of the Earth System, our planet's 'software' (Magalhães et al. 2016).

Because the Earth System is shaped precisely by the intangible interacting physical, chemical and biological processes that cycle materials and energy throughout the system at the planetary level, it should not be owned, enclosed or disposed of (i.e., divided and appropriated) by any State or entity, if there is a threat of permanent damage being inflicted on the inner structure of that processing system. Humanity shares, even without being clearly aware of this, all these processes that are conducive to maintaining a favourable state for us to thrive in, both in physical space and along the generational timeline. In this sense, the biogeophysical structure of the Holocene epoch is part of the international common heritage (patrimony) and therefore *belongs in usufruct to all humanity in common* (Banning 1995).[7]

Given its dynamic cross-cutting nature, the biophysical life support system of the Earth should be considered, beyond any reasonable doubt, as the most critical of the "commons". Therefore, it should be used, but not owned, either as private or common property or via the claim of sovereign rights (Taylor 2016). Yet these characteristics of "belonging to all but owned by no one" do not necessarily prevent the "commons" from being put to use in an organised and regulated way. From a legal perspective, the regulation and collective control of something must be preceded by a fundamental question: "*How can a good that belongs to no one be subject to a legal regime*?" (Kiss 1982). In other words, if our life support system is a unique favourable state of functioning of the Earth System, how can we regulate its use in the absence of any form of legal representation of this intangible vital good within the realm of international institutions?

The recognition of objects as possessing an intangible or immaterial character is not new to the legal sciences. UNESCO's immaterial cultural heritage, the intangible value of companies in commercial law, intellectual property, intangible orbital slots on the geostationary orbit or frequencies in Space law are examples where the need to organise the use of something, or the importance of the values intended to be protected, have always justified the search for new solutions. These solutions, which have resorted to the legal

[7] The meaning of the "usufruct" concept ("*The earth belongs in usufruct to the living*") was introduced and explained by Thomas Jefferson in 1789, in a letter to James Madison. This letter may be considered the philosophical foundation of the intergenerational justice issue.

recognition of new intangible assets, have proved to be a driving force in shaping today's society and the way it functions. So, what is hindering us from recognising that nature is not only what is touched and seen, but also its most inner, cross-cutting and valuable intangible dimension?

Individuals are not generally aware of the structural importance of these legal solutions, which are the basis upon which our societal institutions are founded. For example, without the legal separation between the intangible idea of an author and the tangible support on which that idea is recorded, neither would great increases in knowledge be possible, nor the mass dissemination of that knowledge, a key factor for every sector in our social life. The same idea could be applied to commercial law, where often the value of the intangible goodwill of one corporation is incomparably higher than its tangible assets. Drawing an analogy between these intangible legal objects and the intangible nature of the Earth System, which may not be "seen" before it is understood, might also be crucial in helping us to cherish the real value of natural biomes, whose ecological services for humanity are incomparably higher than the economic value of the specific natural hardware generated through those services. For example, the value of forests, which are vital for maintaining nature's capacity to support a favourable environment in which humans may live, only becomes visible in the economic and financial perspective through rush deforestation, turning living trees into dead raw material. In nature, too, the most valuable types of heritage are those beyond sight and touch.

In a recent work on the Global Commons in the Anthropocene, a set of critical biomes are defined by the fact that they "play a decisive role in regulating the overall status of the life-support system on Earth, that is, how well Earth can support world development" (Nakicenovic et al. 2016).These biomes are tangible and geographically and territorially enclosed, and almost all of them (with the exception of Antarctica and the Artic) are under the jurisdiction of one or more States. From a legal point of view, it is entirely unfeasible to recognise them as global commons, and accordingly, to consider their governance as a global and critical problem. Nevertheless, these biomes produce and provide intangible natural services that are disseminated throughout the planet, benefiting humankind and the biosphere as a whole. What is at issue here is the inability of State sovereignty to cope with the intangible value of the commons that cross its political geography, let alone to offer them adequate and necessary protection.

The reality is that our planet cannot be regarded simply as a geographic area of 510 million square km^2. In fact, all the known terrestrial planets share the same metric feature. What the others do not have, however, is an intangible and dynamic system embedded with strictly physical planetary hardware, capable of sustaining life as we know it. From a legal point of view, the planet is basically reduced to its territorial nature. This one-dimensional view ignores the most outstanding and vital expression of nature, the absolute singularity of the dynamic software that beats as the real heart of our living planet.

3.2 The Struggle for Non-Territorial Global Commons

When climate first entered the UN agenda, a fundamental question immediately arose: what is a stable climate from a legal point of view? The difficulty in answering this question was linked to the fact that climate is fully interwoven with the non-territorial ecological dynamic of our Earth, which crosses and transcends political borders. The thorny question regarding the nature of a stable climate was thus at cross purposes with the foundations on which International Law itself was built. Malta's first proposal (09/1988) to frame this new issue was to recognise a stable climate as Common Heritage of Humanity, which implied the conceptual innovation of legally recognising the existence of a common good that permanently circulates the territories of all sovereignties, both *internally and externally*. To get around this issue, in December of the same year, in UNGA Resolution 43/53, a further concept derived from the concept of common

heritage was coined, but with impoverished wording: climate change was defined as a "Common Concern of Humanity". This option of addressing climate as a "concern" remains within the legal framework of the Paris Agreement to this day, and certainly paved the way for how societies are tackling climate change. Whether we like it or not, its shallow substance and characteristics are inevitably linked to the (lack of) results achieved.

The "common concern" is a vague political statement, which does not define specific rules and obligations but rather establishes only a general basis of cooperation for dealing with something that concerns the largest possible human community. In this system, those involved undertake to make an effort to mitigate or neutralise damage, but since the common good is not recognised, it is not possible to build a truly institutionalised management and governance system that ensures the permanent maintenance or restoration of this common good (in this case, a stable climate).

Had it been agreed that a sound and stable climate is our common heritage, the situation today would likely be different. We would probably have in place the two most basic design principles (DPs) that the economic history of long-enduring experiences of Common-Pool Resources (CPR) management define as the structural conditions for successful "collective action", aimed at the sustainable use of common goods (Ostrom 1990). The first of these states that the nature and limits of the CPR must be clearly defined. The second principle requires "congruence between appropriation and provision rules". By analogy, in the case of the urgent need to preserve a stable climate, this would mean a need to establish congruent rules between those who provide a stable climate and those who benefit from this common good.

According to Ostrom, there are eight DPs, and in the current climate policy, because these two first principles are not in place, all the subsequent others are also missing. Consequently, the option of considering climate simply as a feeble "concern" creates a huge gap between two very different worlds:

(a) The "concern" concept implies a world in which a key global common that spans across borders is not recognised (current legal status). The "common concern" relates to an ill-defined "problem" and fails to define a real object of international law—the common good itself—and consequently, it is impossible for rights and duties to emerge from the provision or appropriation (usufruct) of that common good. (Scholtz 2014). Within the "common concern" approach, climate change is an "issue", and a stable climate is not acknowledged as heritage that belongs, as an existential condition, to humankind as a whole. Therefore, the provision of a stable climate in a "common concern" framework, namely cleaning the atmosphere for the benefit of humanity, is the same as cleaning something that belongs to no one. It is a positive action lost in a legal void. The "concern" element presupposes that States are subjectively inclined towards joint and concerted actions" (Tolba 1991). "Common concern" is only a general framework for loose cooperation, and is a long way from an appropriate management system that is necessary in order to care for and restore a common good. This is the main reason why today there are no economic incentives for the provision of a stable climate, namely using policies to mitigate and actively restore the balance regarding the ever-increasing concentration of greenhouse gases in the atmosphere. What we actually have, on the other hand, is a badly designed and poorly performing mechanism of "voluntary obligations" to share the burden, aimed at reducing new emissions, but forgetting the need to remove the CO2 already in excess in the atmosphere. This mechanism sets up a negative-sum game where the "stable climate resource" constantly decreases, due to the lack of an economic instrument to stimulate and pay for negative emissions. In a knock-on effect, the legal non-existence of the common good further prevents the emergence of an economy empowered to

preserve and restore a stable climate. All the benefits that could foster concrete and cooperative efforts to maintain and restore a stable climate disappear in the vortex of this *global legal gap* that means these benefits cannot be translated into economic value.

(b) In a totally opposite direction, the "heritage" concept considers the stable climate as an intangible legal object across borders, i.e., a common good that can be the object of an international system of governance, where the unrestrained appropriation of the common good (negative impact) is considered as a value-loss, and most importantly, the provision of the common good (positive impact) can be considered as a value-gain in the "common heritage". In this scenario we have the structural conditions needed for the ambition we are really seeking to achieve, i.e., an economy capable of actively cleaning, restoring, and maintaining a stable climate. Giving economic visibility to the output of the intangible benefits produced by nature would be a real *game changer* in the global economy because the value of natural services and assets would become directly visible in national and global GDPs. As a consequence, not only would countries attempt to cause minimum harm, but they would also be encouraged to add the maximum benefit possible to the common heritage in addition to enabling collective action, this would also drive us to protect and restore nature, without threatening the sovereignty of the countries where those key ecosystems are located.

This issue was clearly identified by Mostafa Tolba, one of the founders of the "concern" concept and executive director of the United Nations Environment Programme (UNEP), who stated in the early discussions: "It is very important that the concept of "common concern of mankind" is further elaborated to make its contents and scope understandable and clear; it is also important to make sure how this concept can be interpreted in the terms of the rights and obligations of states in the process of its implementation." (Tolba 1991). Thirty years later, this seminal challenge still remains unanswered and off the discussion agenda. The current model of considering climate change as a common concern has clearly proved to be insufficient. It functions, on the contrary, as an obstacle to social and collective action aiming for sustainability. Climate change is not simply a concern; it is also, and above all, a structural problem in our society and, most importantly, a stable climate is a heritage that belongs in usufruct to all generations. Only by intervening in the structure of the problem will we be able to aim for a different result, avoiding decades of successive failures of climate negotiations based on wrong assumptions.

Mostafa Tolba, besides accurately foreseeing the huge challenge ahead in order for the "common concern" concept to have any chance of producing a successful outcome, was also very insightful in predicting the resulting risks and pernicious impacts that would occur if the desired effects for which the concept was created were not achieved: "Joint efforts of governments, scientific community, scholars and public opinion are of crucial importance for the concept of "common concern of mankind" does not rest as just a vague political formula, which could be used to legitimize lack of concrete actions by simply declaring an environmental concern" (Tolba 1991).

3.3 The Commons and the Need for Innovation in International Law

In recent years, the Earth System sciences have produced a significant paradigm shift, unfolding a new way of systemically thinking about the Earth as a fragile and complex entity. The new paradigm of the Earth System sciences and the advent of the Anthropocene epoch calls for a comprehensive and multidisciplinary study of the co-evolution of natural and social sciences, as wise scouts of a new way for humanity to inhabit the Earth within those ecological boundaries that it would be unwise to cross.

There is, however, a formidable gap between the growing knowledge of the Earth and our negative impacts on it, and the ability to make the civilisational reforms that can reverse the current course that is leading us at accelerating speed towards a dire scenario of a "Hothouse Earth" (Steffen et al. 2018). Pursuing a strategy towards a "Stabilised Earth" pathway will require much more than a dramatic technological transformation, or the loose establishment of carbon pricing regimes. Humanity is an integral and active part of the Earth System; consequently, there is an intimate connection between aggregate human activity and global, interdependent biogeophysical cycles. The Anthropocene implies, therefore, that legal systems should be able to tackle, in a normative manner regarding the regulation of our actions, the real possibilities and constraints deriving from the functioning of the Earth System. Otherwise, we will fail the historical task of maintaining the Earth System within the "Safe Operating Space". This concept originated from a strong body of scientific findings and proposals, including the "Planetary Boundaries" (PB) framework, which was first published in 2009 (Rockström et al. 2009), and revised and updated in 2015 (Steffen et al. 2015). This research provides useful elements and concepts to better understand how the Earth System functions.

The PB framework is based on nine key Earth System processes: climate change, stratospheric ozone depletion, land system change, freshwater use, biosphere integrity decline (including genetic and functional diversity), ocean acidification, biogeochemical flows (as phosphorus and nitrogen cycles), atmospheric aerosol loading and introduction of novel entities. These are the science-based limits that determine the balance of our Earth System, which was essential for the rather favourable epoch of the Holocene, the cradle of human history. If the PBs are transgressed, the risk of the Earth System being driven out of the Holocene stability epoch increases rapidly. It is important to highlight that the most critical scientific principle that underpins the PBs framework is that the *Earth System functions as a single integrated system at the planetary level*. If a single PB process is addressed in an isolated way, all the other critical elements that interact with it will be ignored, as well all the feedbacks and domino effects that will happen throughout the whole system as a result of the interaction of PB processes. This means that, more than sectoral, geographic, institutional or implementation gaps, we suffer from a substantive mega-gap, of a hybrid nature, which is both epistemological and moral. Although knowledge and reason invite us to accept the condition of being full members of the Earth System, a powerful part of our will leads us to consider the Earth as a mere trophy to be conquered and plundered, as if we were transit passengers waiting for a spaceship to some other unknown place in the universe.

4 Conclusion: The Way Ahead

Portugal was the pioneer in recognising a stable climate as a common heritage of humanity.[8] This is a positive step, but only the first on a long road towards the recognition of a new culture of the commons, which humanity, the international community of states, international law, the economic system, the scientific community and each of us individually must pursue and implement, in words and deeds.

We are engaged in a dramatic race against time. At this moment, if this necessary change does not take place, all the evidence suggests that the goals of the Paris Agreement, even the less ambitious ones, will not be achieved. Even if the OECD countries meet their targets for reducing greenhouse gas emissions, the two dozen major countries that are not part of this organisation (including countries the size of India, Brazil, Indonesia and South Africa) will continue to increase the GHG concentration in the atmosphere, making the Hothouse Earth scenario increasingly inevitable (Gallagher 2022). Can we blame the leaders of those countries that

[8] On 5 November 2021, the Climate Law (Lei n° 98/2021) was approved by a large majority in the Portuguese Parliament. Article 15 f) of the Law defines "The recognition by the United Nations of a stable climate as a Common Heritage of Humanity" as an objective of Portuguese climate diplomacy. Portuguese Climate Law, 12/2021: https://dre.pt/dre/detalhe/lei/98-2021-176907481.

foster energy consumption to continue to lift their citizens out of the current very high levels of poverty? Would it not be fairer to consider as more reprehensible the indifference of the developed countries' elites, who refuse to support, through technological and financial transfers, the transition of non-OECD countries to more sustainable models of energy production and consumption?

The illusion of sovereignty in a world governed by a totally interdependent Earth System has become a deadly hallucination. This is not mere selfishness, but a gross error. If we are not able to build a new kind of common dwelling of the Earth, rooted in institutions of compulsory cooperation, in which all actors share responsibilities and benefits, then the only thing that will be experienced in common, not far away in the future, will be the immense tragedy of seeing the global environmental crisis plunge into a civilisational and ontological collapse with no return option. The time for realistic hope seems increasingly short. Therefore, there is no alternative but to struggle for the defence of an Earth where our children and grandchildren and all future generations can have a place.

The unity of the Earth System does not allow for separation between "us" and "them", nor the digging of borders of indifference between "today" and "tomorrow". We are all, wherever we are in space and time, passengers on our one, only and magnificent Blue Planet.

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Human Responsibility for the Protection of Our "Common Home"

Michel Renaud

Abstract

This chapter attempts to explain ethical behaviour in the protection of the environment. It begins by analysing the lived space as a place of inhabitation and outlines the differences between subjective and cosmic time. The metaphor of the "blue planet as our "common home" then makes sense". To understand the notion of ethical responsibility, the relationship between ethics and politics is considered. For this purpose, we follow Levinas and Ricoeur's suggestion, which distinguishes responsibility as an imputation and as an assumption of a commitment for the future. Responsibility as imputation is directed towards past acts, as opposed to the more specific ethical responsibility facing the future. The need to overcome the obstacles revealed by Pope Francis' Encyclical *Laudato sí* thus becomes clear, in view of the experience of human solidarity in the face of the protection of our planet.

Keywords

Environmental ethics · Nature · Space and time · Responsibility · Solidarity

1 Introduction

Respect for the nature that surrounds us is a value that has never been forgotten, even though each society has different criteria regarding the extent of that respect. But when we refer to nature, what are we talking about? We know for a fact that the very concept of nature is determined in a number of ways. There is the nature-cosmos, with the galaxies and the entire intersidereal universe; there is also the nature of the terrestrial world (*terra-gê*), with the space that surrounds it. Then, we have the nature-bios, which encompasses all living beings; and within this group, there is the specific case of the human body (*soma*), in its somatic natural dimension. The study of nature (*phusis*) in the most general sense is the task of physics, with all its ramifications. And yet, nature has its own philosophical sense: when speaking of the nature of things and of reality, we unlock the question of their essence, of what they are in themselves. Philosophy has studied the essence of things, since Plato and, above all, Aristotle. While physics is dedicated to understanding the texture and functioning of nature-matter, philosophy, for its part, seeks to analyse the meaning of reality, at the intersection between natural reality itself and the essence of reality for human beings.

As we follow this path towards understanding nature, an ethical question arises: how should humans behave in relation to matter, in the indefinite multiplicity of its natural forms? And what

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will the ethical basis of this behaviour be? Is it possible that nature—physical matter—contains the basis for its preservation within itself? The question is relevant to the issue of ecology when one is seeking the ethical basis for the preservation of nature. In other words, would it be correct to think that the basis of morality lies in the obligation of total respect for material nature itself? Actually, the question is incorrectly put and the answer to it must be a negative one. In fact, it is through dialogue between human reason and reality that the basis for ethical action can be discovered. The inherent value of protecting nature cannot only be seen from the aspect of total respect for material or biological nature, which would prohibit any human intervention of style, for example surgical intervention. From this point of view, various trends in "deep ecology" make the mistake of thinking that respect for material or biological nature prohibits any change arising from human organisation, as if all living beings, animals and men, had the same status and the same right to their preservation. An example of this situation occurred during the construction of some sections of a Portuguese highway. The project was opposed by some groups concerned about the environment, on the pretext that this was an exclusive space where one type of a certain species of snakes lived. In any case, the basis of ethical behaviour in ecological issues, as in all other fields of action, is found through the intervention of human reason that considers the values that should guide human action.

This brief introduction opens the door to the study of the relationship between ethical behaviour and ecology as protection of the natural environment. Given the etymology of the term ecology—discourse about the home, i.e. about inhabiting—it will be helpful to clarify what is living space and space in general, and also the time in which our individual or collective life is included, in relation to the general concept of time. It is necessary to demonstrate that there is an irreducible gap between physical space, studied scientifically, and inhabited space, between cosmic space and phenomenological space. Likewise, we must note that time measured by clocks is neutral time from the point of view of the life of each human being. On the other hand, time lived and described by phenomenology is personal and marked by emotion. There is, therefore, a large gap between scientifically described time and phenomenological time.

On the basis of such considerations, what conclusions can be drawn about the sense of human responsibility for the protection of nature from the ethical and political perspective of global ecology? It is with this concern that we will begin by briefly characterising the way in which phenomenological space and time differ from cosmic space and time. We will then go on to question the meaning of the expression "Common home" to label the terrestrial world, the "blue planet". Our fourth paragraph will briefly raise some issues regarding the relationship between ethics and politics, in order to, finally, address the fundamental issue of human responsibility for the future of the planet.

2 Space as Housing

The first space occupied by each human existence refers not to the first inhabited house, but to the mother's belly, a space totally interior and only partially visible thanks to medical technology. If we also leave aside the space where births generally occur nowadays, i.e. hospitals, clinics or other places more suited to the performance of childbirth, the home is the first dwelling place of human beings. But until the possibility of recollection appears, in the first years of a life, the home is not an object of conscious memory. Yet, it continues to be the first place of reference. While quite trivial, this observation demonstrates that perception of space is acquired progressively, but this acquisition never occurs in a pure way, that is, disconnected from the subjective perceptions, emotions and feelings that accompany it. Accordingly, phenomenology seeks to describe the way in which space is, firstly, a lived space, before becoming an object of reflective consciousness. Several conceptual pairs are presented in this description.

The first of these is the relationship between retreat and shelter. The dwelling is the place of

retreat, through which a separation is made between the common or public space, capable of being shared by all, and the private space, that is, reserved space. The concept of separation, which is presented here, is fundamental to the description of the living space; it is not just a matter of stating that access to the space of one's own dwelling is, in principle, prohibited to those who are not invited to enter. A resting place, the dwelling allows for the retreat intended for the many tasks left to the initiative of its occupants. In *Totality and Infinity*, Emmanuel Levinas analysed this meaning of *dwelling* from various points of view (Levinas 1961, p. 153). "The whole of the civilization of labor and possession arises as a concretization of the separated being effectuating its separation. But this civilization refers to the incarnation of consciousness and to inhabitation". In fact, the dwelling is, *par excellence*, the place reserved for private life. Political philosophy deals with the difference between the private and public spheres, and with all the difficulties that lie behind this simple duality. It should also be noted that one of the unfortunate characteristics of contemporary culture lies in the blurring of the lines between these two spheres; entertainment programmes from the Mass Media, from television and from presentations from social networks contribute to making this dividing line more fluid.

Inhabited spaces always have emotional connections and are valued by their occupants. This characteristic means that we can see the difference between a place as it is lived in a human sense and a still empty space that physics speaks of. One of the features of this valuing of space is the vision that is projected, from the inhabited space, onto other surrounding places. Indeed, human space is established by intervals between places that constitute a point of reference. The idea of a completely empty space is, so to speak, deadly, like a desert where there is nothing to point to the existence of privileged directions. In myths and even in the first lines of the Bible, the moment that precedes creation presents itself, in an imaginary way, as a *tohu-bohu*, that is, as the space of primordial chaos. This means that space becomes human when there are different places, filled with intervals. In the opposite sense, the space and spaces of physics constitute an abstraction in relation to inhabited spaces. Indeed, physics sets the human dimension of space apart, in order to better understand its intrinsic laws. For example, the theory of relativity is not immediately interested in the intervals that separate the places inhabited by human beings. For physics, terrestrial space does not present itself as a "common home" for all the inhabitants of the earth, whereas for human beings, space is primarily where every human being is called to live his existence. Everyone lives in space, if only because, due to its volume, the body itself occupies a portion of non-shareable space. The occupants of an overcrowded bus know this better than anyone. In addition, each of us needs our own surrounding space, from which the dwelling is the initial reference point. On the other hand, it is in the emotional encounter, lived in friendship and love, that the desire for physical and reciprocal closeness arises, symbolically conjuring the real and figurative distance that separates us. Hence, it is by reference to the lived and subjective space that we extend our mental horizon to the unrepresentable dimensions of the cosmic universe.

3 Time Lived and Cosmic Time

Like space, time is first and foremost time lived subjectively, before there is any reference to clock time. This truth is not limited to the child's experience of time; for children, time passes slowly, almost standing still, given their desire to grow up quickly. In contrast, the experience of older people is that time runs away; we would like to hold back time, which brings us closer to the exit from this world. Likewise, for adults, a day of vacation passes in a minute, but it seems very long for colleagues who, during those same hours, are still at work. It will not be necessary to provide many examples of this experience of subjective time. The conclusion we can draw is simple, but not always explicitly conscious. Before we understand objective or cosmic time, that is, time

measured by the succession of hours and the nychthemeral alternation of day and night, human time is understood subjectively and emotionally.

There are thus two ways of understanding time, which we might call time experienced by human beings and, on the other hand, time that is void of all subjective connotations, as time objectively calculated in hours, minutes and seconds, as well as in days, months, years and centuries. Without this objectification of time, which rests on a methodological abstraction, it would not be possible to share our human experiences. We know that subjectively lived time is incorporated into objective time, as the events of our lives can be dated. This does not prevent these two styles of temporality. In fact, the concept of temporality refers primarily to the temporal and lived dimension of our existence: from Husserl and Heidegger, with the addition of the precious analyses of French philosophers (Gabriel Marcel, Jean-Paul Sartre, Maurice Merleau-Ponty and Paul Ricoeur), phenomenology has shown that the human being is time, which means much more than simply saying that he was born on one day and will die one day in the future.

If we now ask ourselves whether subjective and objective time can be reconciled, our answer has to be negative. It is precisely this impossibility of reconciliation that constitutes the difficulty in concretising a phenomenology of time. As for the objective aspect of time, we know that the physics of relativity has proven that there is a relationship between cosmic space and time; but, for us, this knowledge only accentuates the heteronomy between phenomenological time and physical time. And Paul Ricoeur has the merit, in his great trilogy *Temps et récit* (Ricoeur 1983, 1985a, b), of having shown that, in the first place, there is not, strictly speaking, a reconciliation between lived time and physical time. Then, the only conciliation, however imperfect, lies in the narrative. But what is the scope of the narrative? In fact, there are at least two types of narratives: those of historians, which aim to reproduce the past, and fictional narratives, both of novels and of other stories invented in the field of literature.

In this regard, Paul Ricoeur, in his work of almost a thousand pages, exposed the following theory: the history of historians and stories of fiction follow similar criteria in the constitution of narratives, even though their reference to reality is different. Indeed, fictional literature also has its referent in reality, which is situated on the reader's side of the world; stories narrated in fictional literature allow the reader to interpret and understand his world in a different way, precisely through the comparison with fictional existences that present themselves as real possibilities for life. The concept of the world that is in focus here does not identify with the objective material world that surrounds us, but evokes the subjective understanding of our own existence in the context in which we live. Therefore, reading fictional works shows us other ways of inhabiting the world. However, the same is true when reading the works of historians. Besides the claim that historians have to bring back to the present a past that has definitively passed, their books also show us real possibilities of living in today's world.

Everything happens as if the *real referent* of works of literary fiction were situated, not primarily in the elegance or originality of the style, but in the enrichment of the self-interpretation that the reader acquires through his contact with imagined worlds. Now, the real referent of historical narratives is also located in the field of the reader's subjectivity and interpretation; but beyond that, the historian cannot waive his own subjectivity. This is why reconstruction of the same historical events can give rise to interpretations that differ greatly.

It will now be useful to recap the results of this analysis. The confrontation between cosmic time and that of human subjectivity demonstrates real heterogeneity between them. However, partial conciliation is achieved through the medium of narrativity. Both forms of narrativity—the history of historians and that of the creators of fictional literature—show that the understanding of time is primarily rooted in how human beings interpret their own experiences in the course of their existence. The unity of human existence thus implies understanding of lived time, through the

narrations that each human being can make of himself and of others.

4 The Blue Planet, Our "Common Home"

The analysis of specifically human space and time is an entry point to approach the current issue of ecology and respect for the balance that will enable us to maintain life on Earth. For this purpose, the excellent text in Pope Francis' Encyclical Letter *Laudato Si': On Care for Our Common Home* will be of help to us (Francis 2015). This remarkable document was hailed by the great French epistemologist Edgar Morin, an atheist, as the most comprehensive document on the ecological theme of protection of the Earth.

The first question raised by the "*Common home*" is the actual meaning of the expression. Indeed, to speak of the Earth as a *Common home* is to construct a metaphor. Instructed by Paul Ricoeur's book on *The Living Metaphor* (*La métaphore vive*) (Ricoeur 1974), we know that the first point in interpreting a metaphor is recognising the aberration of its literal meaning: the Earth is not a home, and much less a common home. In fact, a home has very restricted space and limited duration, even though it may last for centuries. After this necessary denial of the literal meaning, we may, if it is an authentic metaphor, look for the symbolic sense that gives it its relevance. A metaphor differs from an analogy in that it expresses something that is inexplicable, but that makes sense, that is, that makes us see reality in an innovative way, precisely by bringing together two fields that are semantically alien to or distant from each other. In this case, the only overlap between planet and home is symbolic. To access the metaphorical meaning, we must look for the effect of the innovative meaning that comes from this non-relevant association of two concepts or expressions. The task ultimately then is recognition of the *referent* underlying the metaphorical expression. The referent must reveal what, ontologically speaking, we have come to learn from the reality—here, from the blue planet—through the linguistic and meaning-creating mediation inherent in the metaphorical association of the *blue planet*, on the one hand, and the *common home*, on the other.

What then does the referent of the present metaphor mean? Being inexplicable in a totally transparent way, it suggests that our Earth should become a habitable place for all its occupants without exception, with all the consequences that derive from this objective, namely from the point of view of respect for the Earth's ecological balance. The referent of the expression "*Common home*" in relation to the Earth is not only presented, therefore, as a poetic way of looking at planet Earth, but evokes the call to transform it into a space that is hospitable to humans and will be for a long time. Similarly, the expression entails a twofold emotional investment; it is worth having a dwelling that is a retreat and shelter and that we like; on the other hand, life is a good, the fundamental good thanks to which we can apprehend all other material, cultural and spiritual goods. We are, therefore, transported back to the properly human sense of space and time, but in a clearly ethical and global perspective. In this way, it is a worldwide ethical project that the development of this metaphor evokes. Making the world habitable, not only for our generation, but for future generations, requires the commitment of all. Is this possible at a global level? The issue is equally ethical, social and political.

5 On the Relationship Between Ethics and Politics

Until a few decades ago, ethics treaties favoured personal ethics. They sought to determine the ultimate purpose of action, and also to link the purposes covered in a kind of ever-widening circle. Furthermore, the understanding of moral good and evil was primarily confined to the exercise of personal and individual freedom. Everything happened as if the criteria of ethically good action were rooted in a free, personal and autonomous decision (Ladrière 1997). Social ethics, of course, was never forgotten, but it seemed to refer

to another type of approach, which was not identified with that of personal ethics.

A cultural fact appears to have been responsible for the change in this situation, this being the importance given to cases in which ethical decisions are taken not individually, but collectively. Here actions are discussed from an ethical point of view, but involve a variety of decision makers. In this aspect, bioethics has contributed greatly to increasing awareness of the change in this situation. For example, when a decision needs to be made in a hospital on matters that concern scientific research, or more complex problems, the hospital ethics committee is called upon to pronounce, giving an advisory opinion. However, assessment of issues submitted to various decision makers does not necessarily lead to agreement. If the final decision is taken by a majority, as is the case predominantly in relation to so-called divisive issues (regarding the beginning and end of human life), we witness a kind of politicisation of the ethical standpoint.

Indeed, it is worth noting one of the main differences between ethics and politics. In the exercise of political life, at least in democratic countries, those chosen to govern are selected on the basis of electoral scrutiny. Majorities have the power to decide. In ethical life, the opposite is often the case; progress in ethics generally derives from active minorities, who live by the new ethical values before they become generally accepted and are potentially incorporated into the laws or the Constitution of a State. International history is full of great figures whose *ethical* actions were, in the beginning, and from a political point of view, singular and largely minority. However, the issue here is not to state that the ideal of ethics is for all ethical values considered superior to be incorporated into political laws. Indeed, it is not within political power to impose on citizens the meaning they should give to their existence.

Regarding ethics opinions, one might ask why these are merely advisory rather than binding. The reason is simple but decisive; ethical behaviour is not imposed, but rather proposed. In fact, that is why ethics has the task of writing non-binding recommendations and opinions, or otherwise it would become a forum for political decision-making. Ethics proposes values rather than positive laws to be followed. However, in the case of fundamental ethical values of life in common, and when these values are agreed on by the vast majority of the population, the legislative power integrates them into positive laws that must be complied with or otherwise legal sanctions will be imposed. It is, therefore, normal that the Constitution, in the first place, and the political laws that follow are the political vehicle of very many ethical values.

When a decision on social *ethics* is taken by the majority of the decision makers, there is, clearly or surreptitiously, an inevitable politicisation of ethics. This was the case in the recent major debates on euthanasia or complex cases, such as the use of medically assisted procreation, etc.

As opinions issued on specifically ethical issues are not binding, policy makers are not obliged to legally ratify the decisions of Ethics Committees or the respective National Ethics Councils, which have proliferated in most democratic countries over the last forty years. That is why each national community has its specific ethical profile, potentially with serious ethical gaps. This is the case in Belgium, where a law was voted on that allows euthanasia for persons with a mental illness, and in Trump's America, which denied human responsibility for climate change and the urgent need to take necessary measures to protect the Planet.

In the field of ethics based on discussion, in the sense described in the works by Jürgen Habermas (*Diskursethik*), it should be possible to reach an agreement on a fundamental *ethical minimum* that is also valid internationally. For social ethics, the expression *ethics of minimums*, present in the works of Adela Cortina, extends the idea of the "ethics of discussion", and could be a source of support for the establishment of global ethics. Thus, a possible bridge would be found between ethics and politics. However, the great risk is that this "*ethics of minimums*" might be insufficient, given the great challenges that the world is currently facing.

6 The Common Home and Responsibility for the Blue Planet

When our world became aware of the march of globalisation, with the impact of the Mass Media, of culture and of economics and finance, enthusiasm seems to have been the first reaction of most societies living with a certain level of economic well-being. The possibility of watching events right across the globe in real time fuelled dreams that are aptly described in Pope Francis' recent Encyclical Letters, *Praise Be to You - Laudato Si': On Care for Our Common Home* (2015) and *Fratelli Tutti* (2020). But recent years have made us more aware of the disillusionment that has arisen in the light of societies' inability to come together to solve some of the world's largest problems: poverty, migration, access to clean water, deforestation, climate change and ocean pollution (Neves MC 2017). However, awareness of a collective responsibility for the future of life on the planet has grown.

In 1979 Hans Jonas published his book *The Imperative of Responsibility* (*Das Prinzip Verantwortung)*, which became a major classic on the subject of the rights of future generations. At the beginning of the book, announced as a contemporary reply to Kant's categorical imperative, the author presents his overriding moral imperative: "Act so that the effects of your action are compatible with the permanence of genuine human life." This principle warrants some comments. Firstly, it forms the basis of an ethics and not merely a policy, although it has to be brought into the political discussion at the same time. Then, it appeals for a duty of responsibility of human beings to promote a peaceful, common and long-lasting coexistence on earth. It insists not on the priority of good ethical intentions, but on the duty of concrete achievements carried out in common, because each human being must be confronted with the same purpose. But, one might ask, how can human beings of future generations have rights over us? They do not yet exist, and cannot therefore be holders of rights. This is true, but the Hans Jonas principle speaks of the duties that the living have to ensure the viability of fully human life on earth. And what is the basis of this principle? The question is clear, but the answer is not as easy as you might think; indeed, it implies universal acceptance that it is better to live than to die. It is better for human beings to take responsibility for the permanence of human life on earth than, through their inertia, to contribute to collective suicide. The calculation has already been made that, if measures are not taken within a very short period of time to stop the rise of waters on the globe, one billion people will surely die, those people who on the surface of the globe live on the edge of maritime waters.

Why is it better to live than to die? Besides spontaneous evidence, it must be remembered that life is a gift; we are indebted to life itself, which has been handed down to us. For believers, this gift has a transcendent and personal origin, which we call God, and each religion can give it a specific name, The Heavenly Father, Yahweh, Allah, etc. However, whatever our understanding of the origin of life and of our planet, we are all jointly responsible for the future of life on the planet.

In this regard, let us remember, following Emmanuel Levinas and Paul Ricoeur, that the concept of responsibility, first of all, has two different meanings (Ricoeur 1995); the first is imputability, a term of much older origin, in the sense of connecting a fact or event to the person (or persons) that caused it. This meaning of responsibility as an investigation prior to imputation looks at the *past* fact, already undertaken or still in progress; this is the meaning that corresponds to the legal work of judges in criminal matters. But there is a meaning that is primarily ethical, referring to the taking of responsibility. In this case, responsibility corresponds to the answer to a forward-looking question: who can take responsibility for this person, for this cause? The person or community that, with due capacity, agrees to take on this responsibility becomes *ethically* responsible. Hence, responsibility appears as a response to a question of imputation or as a response to a question that requires a commitment to be assumed. It is in this latter sense that responsibility for the

future of our *Common home* requires personal, individual and collective participation; it requires a joint ethical and socio-political commitment. But this is not without its obstacles.

As the aforementioned Encyclical Letters indicate, it is individualism, the unbridled desire for money and the pursuit of immediate pleasures that prevent people from adopting an attitude of accountability. On the other hand, in democratic countries, as opposed to countries that live under a dictatorship, it is difficult to make important long-term projects viable, as there are personal interests that often justify short-term electoral programmes. There is also another obstacle that has become cause for concern for the future. Contemporary technoscience has demonstrated that a single intelligent but perverse being might have the capacity to invent a deadly virus responsible for new pandemics or capable of spreading chemical or other poisons, endangering our collective existence.

However, the obstacles that will always exist cannot and should not be a source of pessimism. Indeed, the meaning of human life stems from the understanding of the human being himself. The latter exists as a conscious body, but with a constitution oriented towards encounters with others. This orientation does not suppress loneliness; every human being has to live with loneliness, even in the most fulfilling encounters of his personality. But, paradoxically, it is the case that only a person who is also capable of forging bonds with others is capable of assuming his solitude. Total loneliness is unbearable and deadly; even in monastic life or the life of a hermit, solitude is only healthy when it is filled with faith in the presence of God. This truth is transposed into ethics: selfishness ends up locking the human being into a destructive solitude. That is why happiness lies in being open to others, whether they are beings close to us or distant inhabitants of the earth. This situation is also transposed into politics and supranational relations: if national communities close themselves off in the solitude of their wealth and well-being, they will be destined to encounter emptiness and unhappiness.

After all, when it is said that the human being is not just a body, but a spirit, what is meant is that this specifically spiritual aspect consists of each member of the human community finding himself through encounters with others who share the same terrestrial space and the same life span. Similarly, this encounter with those living today may develop awareness of our solidarity with those who have gone before us and with those who will succeed us on this planet. In a way, human death could also be accepted as a selfless service by which we agree to leave our lived space and time, so that others can also live their happiness. This statement adds to the important meaning that faith gives to death for believers. Indeed, it is the spiritual dimension that is the unifying factor for all the members of the human community.

Many women and many men have lived and continue to live in this spirit of solidarity; they are the best guarantee that the human community will act effectively to make our blue planet an authentic common home.

By way of a conclusion, we leave the reader with an extract from paragraph 160 of Pope Francis' Encyclical Letter *Laudato Si', On Care for our Common Home*: "What is the purpose of our life in this world? Why are we here? What is the goal of our work and all our efforts? What need does the earth have of us? It is no longer enough, then, simply to state that we should be concerned for future generations. We need to see that what is at stake is our own dignity. Leaving an inhabitable planet to future generations is, first and foremost, up to us. The issue is one which dramatically affects us, for it has to do with the ultimate meaning of our earthly sojourn".

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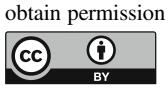

Scientific Knowledge: Its Impacts on Judicial Decision-Making and International Law in the Era of Sustainability

Emily Sipiorski

Abstract

Science has become a tool for taking decisions in international (as well as domestic) disputes and acts to ensure the relevance of global ecological responsibility. This role of science has become particularly relevant as the sustainable development narrative has grown into a predominant form of global cooperation. The following contribution looks specifically at the role of decision-makers, including judges and arbitrators, and their interaction with scientific knowledge during the decision-making process in international (economic) disputes. Beginning with early cross-border environmental disputes and tracing the increasing inclusion of scientific inputs over the past decades, the contribution critically examines the role of judges in integrating expert inputs into legal decisions and its impact on achieving a more ecologically aware application of the law.

Keywords

Scientific knowledge · Economic law · Systemic integration · Judicial reasoning · Sustainable development

1 Introduction

When the arbitrators in the *Trail Smelter* dispute assessed the parties' scientific submissions, the idea of sustainability, despite already existing in the context of forestry, amongst other uses (Von Carlowitz 1713; Du Pisani 2006), had not yet emerged as a guiding term for global cooperation (International Union for the Conservation of Nature's 1980; Brown 1981; Meyers 1984; Brundtland Commission and Brundtland 1987; French 2005; Ramlogan 2010, p. 201; Beyerlin 2013; Humphreys 2018).[1] The relevant issue in the dispute was pollution emitted from a refinery and the transboundary nature of that pollution. Agriculture on the US side of the border was impacted by industry on the Canadian side: the pollutants had caused harm and affected the profitability of businesses. Thus, while *Trail Smelter* is now characterised as a key environmental dispute, its origins lie in the economic harm connected to that environmental damage. Furthermore, it was the case's cross-border character that allowed the dispute, the inputs, and the arbitral decision to become the basis for later decisions in environmental law and, arguably, a guide in more recent decisions under the umbrella of sustainable

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[1] Arguably, based on more recent judicial decisions and case law, sustainable development has neared a greater designation in international law, possibly attaining some of the attributes of a principle. See its use by the ICJ in the *Gabčikovo-Nagymaros* dispute, infra note 21.

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development. Its positioning as a key case for transboundary pollution can be attributed in part to the methods of analysis used by the tribunal, since the judgment was guided by the use of scientific inputs.

This type of reliance on scientific inputs had already been integrated into aspects of decision-making prior to this decision,[2] and it has been extensively applied since (Riddell 2009).[3] The need for science in international litigation has generally become widely recognised (Rosenne 2007). It can be argued that the value and relevance of scientific expert inputs has substantially increased in the past decades, as the realities of climate change have moved beyond the academic literature and into the public consciousness, forcing the interpretation and application of law to interact in a more scientifically-aware space. Yet little consideration is given to the way in which those expert inputs are assessed, even when they are deemed to be relevant in a dispute.[4] This contribution looks at the use of scientific inputs in the process of assessing legal obligations, particularly in disputes that go beyond the classic definitions of environmental law—thus including the use of science in, for example, economic disputes when environmental issues are at stake (Anderson 2007; Treves 2012; Liao 2017).[5] It is these periphery international disputes that ultimately demonstrate the successful integration of conceptualisations of scientific knowledge and its role in enabling the creation of law for a *blue planet* outside of the systemic boundaries of environmental disputes and regulations.

The following contribution looks carefully at the need for scientific knowledge in the current era of the Anthropocene and its key positioning in several exemplary international legal disputes. The role of scientific knowledge in domestic law is intentionally excluded from this contribution,[6] since the aim is to focus more specifically on the role of scientific knowledge in achieving the narrative of global cooperation through sustainable development. The analysis is framed around representative claims arising out of international disputes brought to the International Court of Justice, under the framework of the World Trade Organization, and in the context of international investment arbitration. This sampling of both development and economic disputes that lean towards environmental factors demonstrates the integration of ecologically-relevant narratives throughout the practice of international law and also reveals the role of scientific knowledge above and beyond more specifically-defined environmental disputes. The text first examines the use of science by judges, before turning to the role of science in the sustainable development

[2] Award of the Arbitral Tribunal Established Under the Treaty Signed in Washington, on the 29th of February 1892, Between United States and Her Majesty the Queen of United Kingdom of Great-Britain and Ireland (Relating to the Rights of Jurisdiction of United States in the Bering's Sea and the Preservation of Fur Seals), Decision of 15 August 1893, Reprinted from Moore (1898, p. 935).

[3] See *inter alia*, Lac Lanoux (France v. Spain), Award, [1957] 12 R.I.A.A. 281; Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, [2010] ICJ Reports 14, paras. 160–168; Whaling in the Antarctic (Australia v. Japan, New Zealand intervening), Judgment, [2014] ICJ Reports 226, paras. 74–246; United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/RW/USA, WT/DS381/AB/RW2, 14 December 2018, Report of the Appellate Body, para 6.84; Dispute Concerning the Delimitation of the Maritime Boundary between Bangladesh and Myanmar in the Gulf of Bengal (14 March 2012).

[4] See generally, de Chazournes (2012). Regarding international trade law, see Fukunaga (2012). The process of scientific-factfinding, as a preliminary discussion to the decision-making also warrants serious consideration. See Mbengue (2012, p. 511).

[5] Beyond environmental law, the issue of scientific evidence has been most prominently explored with respect to the law of the sea, namely due to express recognition of the role of scientific and technical matters in Article 289 of UNCLOS. See e.g., Rosenne (2007, p. 245) (highlighting the ability to use qualified scientific bodies in taking decisions as a departure from other international courts and tribunals).

[6] For substantial literature on the role of scientific inputs in domestic law, see *inter alia* Jasanoff (1997); regarding intellectual property law, see Pottage (2011, p. 621), Swanson (2007), Clifford and Peltz-Steele (2014, pp. 558–560); regarding environmental regulations, see for example, Murase (2017), Čavoški (2020, p. 285), Rimkutė and Haverland (2015); regarding discovery and evidence, see for example, Lynch and Jasanoff (1998), Cole (2001, p. 32), and regarding resource conservation, see for example, Carden (2006, p. 182), and United States, Environmental Species Acts, 16 U.S.C. §§ 1531–1544.

narrative and the accompanying "scientific turn". The contribution attempts to identify the potential for a unified approach to these scientific inputs throughout the sphere of international law, pushing beyond fragmentary applications.

2 The Role of Science, the Role of Judges

Scientific inputs are of no value if they are not afforded credibility by the judges taking the decisions, integrating those inputs as meaningful expressions of truth that can be used to find justice. More generally, courts and tribunals, as legal decision makers, play an essential role when taking decisions on the admissibility of evidence.[7] This power grants the tribunal a certain ability to mould and determine how evidence should be construed in the non-scientific context, beginning with the simple issue of whether such evidence is even relevant to the decision. Relevance of the evidence must first be established before admissibility can be allowed. Once the scientific evidence is admitted and the experts have submitted their reports, potentially being called to the hearing to provide further explanation, that science gains the power of persuasion. It attains a status within the dispute, and while the tribunal is not obliged to give it significant weight, its very existence may elevate the analysis of the dispute beyond the determined legal rationalities and into the field of scientific rationality. This first section looks at both the practice of submitting scientific expertise into opinions and the specific ways in which those inputs are dealt with by international tribunals.

The role played by science, and specifically the role of scientific inputs in the decision-making process, is necessary for an understanding of the development of the law within the conceptualisation of the *blue planet*.[8] While legal theory has extensively explored the role of science in the rule-making stage of relevant domestic and international policy-making,[9] respecting its central position in policy-making in health and environmental coordination,[10] studies on the role of science at the decision-making stage have proven less systematic (Alemanno 2008).[11] There is still work to be done regarding whether such evidence can or should be admitted in legal proceedings. If it can assist in finding justice, the assumption is generally that such evidence ought to be admitted.[12] The gap arises when that evidence is added to the record. How should it be applied to the relevant legal rules? How should the judges and arbitrators judge the veracity of the evidence? Are those individuals equipped to take such decisions without *ex officio* interventions? There is a significant gap in coordinating the approach to these inputs in decisions that lie beyond the sphere of a clear environmental dispute.

[7] In general, see Statute of the International Court of Justice, Article 52 (providing for the right of the Court to "refuse or accept any further oral or written evidence"); International Bar Association Rules on the Taking of Evidence in International Arbitration, 17 December 2020, Article 3(10) (allowing for the parties to submit evidence in addition to the power of the tribunal to independently request evidence on a particular point). For its relevance in the US context, see Brewer (1998, p. 1543) (noting the judge's power to take "threshold decisions" about admissibility of evidence).

[8] While this contribution focuses on the role of science in the adjudicatory stage, not to be neglected in this larger discussion is the central role of science in the creation of certain law—especially environmental law, patent law, etc. In this respect, see for example, Lachs (1992).

[9] Klabbers (2014, pp. 84–85), (acknowledging the interplay between scientific expertise in creating regulatory frameworks and the politics necessary for ratification).

[10] See for example, Meyer (2013, p. 17), (Meyer considers that the work of relevant coordinating organisations, including *inter alia* the Codex Alimentarius Commission and the World Health Organization, "involve[s], in part, the compilation and dissemination of research about technological solutions to environmental problems, a task similar to the compilation and dissemination of other kinds of scientific research."); Ayal et al. (2013) and Helfer (2004).

[11] Regarding the role of experts in the process, see generally, see Ambrus et al. (2014) and White (1965). From the perspective of international politics, see Werner (2014). In the context of European risk regulation, Majone (2017, pp. 8–10) (proposing a probability-based method to ensure consistency in decision-making regarding matters of scientific uncertainty).

[12] See note 7 above.

Timothy Meyer speaks of the value of epistemic cooperation for the purpose of distributing scientific knowledge, thus creating "optimal environmental policies" on a global scale (Meyer 2013, p. 20). The ideal of such coordination at the decision-making stage is complicated by the variety of tribunals involved in such decisions, the numerous applicable laws, and the autonomy of the judges and tribunals in their process of taking decisions.[13]

In the *Trail Smelter* dispute, mentioned above in the introduction of this contribution, scientific submissions were extensive, arguably complex, and key to the ultimate decision reached by the arbitrator. There is no indication that the arbitrators had special knowledge that would allow for a more in-depth understanding of the scientific submissions. The US-appointed arbitrator, Charles Warren, was a respected lawyer and legal scholar. He had won a Pulitzer Prize for a book on the US Supreme Court (The Pulitzer Prizes 2022). Nothing, however, indicates a strong background in science. The Canadian appointed arbitrator, Robert A. E. Greenshields, was a professor of law, dean of the law school at McGill University, and later Chief Justice of the Superior Court of Quebec (Court of Appeal of Quebec 2022; History of McGill's Faculty of Law 2022). Similarly, nothing points to any expertise in science. Finally, the chairman, Jan Frans Hostie, was a barrister and legal advisor in Belgium (United Nations Archive 2022). He was frequently appointed to legal commissions regarding rivers—which points to expertise in cross-border issues, if not specific expertise in the scientific factors that enable the determination of sovereign boundaries.

This legal pedigree of the arbitrators is not meant as a criticism of the interaction with scientific inputs; rather, it remains typical of judges and arbitrators in more recent disputes, especially disputes that interact with environmental law but arise in other contexts.[14] The *Trail Smelter* dispute points to an early integration of scientific knowledge as key to how the dispute would be decided. The conflicting submissions of the parties would need to be assessed. The specific relevance of scientific *facts* would need to be applied to the standing legal framework on cross-border pollution. Despite the legal backgrounds of the arbitrators, the scientific inputs were given a certain agency in the decision-making process. They were highly relevant. The materiality that they represented became essential in taking the decision. It remains unclear how much of the proceedings were focused on those submissions, how much the submissions of one expert or another were attacked and questioned, or how much the arbitrator engaged with the numbers. What is clear, however, is the focus in the decision on those figures and the inclusion of those aspects of the parties' submissions in the final award. That relevance of scientific expertise can be further identified in more recent decisions, and the method in which the judges and arbitrators interact with those inputs in the decision-making space exposes a new dimension to the ability to integrate ecologically-relevant inputs.

D'Aspremont and Mbengue (2014) have already examined the role of fact-finding in international disputes that rest on scientific controversy. Their analysis divides the approaches by tribunals into nihilism, protectionism, and outsourcing, indicating a certain inability by judges to fully interact with the scientific expertise that is put before them. They reason "that when confronted with scientific fact-finding, international adjudicators are dealing with knowledge that is as unstable as the law and which brings them to make a choice between different types of reasoning or rationality. It ultimately makes the argument that the question of scientific

[13] Meyer (2013, pp. 23–24) (pointing to the disconnect between the rule makers and decision makers regarding sanctions as well as under international investment law).

[14] Meyer (2013, p. 31) ("The credibility of scientific information is often a key component of international environmental governance. Legal decision-makers are usually not scientific experts and thus have to have confidence that the scientific record upon which they are asked to decide legal and policy questions is reliable.").

fact-finding inevitably confronts international judges and arbitrators with a choice of epistemic rationality (D'Aspremont and Mbengue 2014, p. 241)." The varying rationalities—the law on one hand, and science on the other—create a divide in the decision-making, revealing an instability when scientific knowledge necessarily intersects with the law, whether in treaties or other agreements. A translation of that scientific information is necessary before it enters the legal discourse.[15] Like any fact brought before a tribunal, that fact is then integrated into the decision-making. And like other facts that require a high level of expertise, the ability to apply legal reasoning with the application of those facts leads to just decisions. The court itself poses its own constraints in this respect, leaving the decision-makers with a choice of rationality.[16]

The various approaches taken by tribunals in relation to those facts expose fragmentary realities even in areas of law that require a cooperative approach. The ability to integrate these scientific sources is often derived from the openness (or vagueness) of the respective treaty provisions.[17] Case analysis reveals inconsistent approaches amongst international courts and tribunals: some appoint independent experts (Simma 2012, p. 230), many assess the data to the best of their abilities, some choose to understand the inputs on a first-hand basis,[18] and others may use the inputs to encourage further negotiation between the parties (Tanaka 2017).[19] This variance also extends to standards of proof when scientific inputs are considered either necessary or essential.[20] Even where respect is given to spheres of law beyond the specific decision at hand, if judges and tribunals are applying different methodologies to assess the inputs, the very idea of sustainability as a matter of law will not be coordinated or effective.

While science has become an essential input in legal decisions within the "blue planet" framework, these various ways in which it engages with law reveal complexity. This results in the need for a certain degree of caution. This caution arises in many senses from the inherent degree of rationality that upholds scientific studies. Phoebe Ellsworth notes that "[b]oth law and science pride themselves on the rationality of their intellectual methods and believe that those methods are designed to analyse questions and reach the correct conclusions by means of reason, free from cognitive or emotional biases. Of course, both law and science often fall short of this ideal at all levels, from the decisions about individual legal cases or scientific studies to the acceptance of general theories. In many ways, the biases that mislead legal and scientific thinkers are similar (Ellsworth 2011, p. 895)." These limitations to the rationality of both law and science make a

[15] Meyer (2013, p. 20) (refers to the translation of "basic scientific research [...] before it can be used in law and policy-making.").

[16] This relates to how and whether the forum can be used with respect to these additional scientific inputs. On this issue in the common law context, see Schiff (1963, p. 373) ("As the forum provided by the State to settle disputes, a court of law is not designed to be a scientific laboratory for the search of objective facts.").

[17] In general, see ILC, Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, UN Doc. A/CN.4/L.702, 18 July 2006 (Report of the Study Group) (ILC Report), 16 ("Rules of international law subsequent to the treaty to be interpreted may be taken into account especially where the concepts used in the treaty are open or evolving. This is the case, in particular, where: (a) the concept is one which implies taking into account subsequent technical, economic or legal developments[.]").

[18] Burlington Resources Inc v Republic of Ecuador, ICSID Case No. ARB/08/5, Decision on Ecuador's Counterclaims, 7 December 2017.

[19] See for example, Southern Bluefin Tuna Case (New Zealand v Japan; Australia v Japan), Provisional Measures, Case Nos. 3 and 4, Order of 27 August 1999, 38 ILM 1624, 1635–36; MOX Plant Case (Ireland v. United Kingdom), Provisional Measures, ITLOS Case No. 10, Order of 3 Dec.2001, 41 ILM 405, 416 (2002).

[20] Sulyok (2017, p. 527) ("Tort law, for instance, uses the preponderance of the evidence standard, i.e., the balance of probability. By contrast, there is no generally agreed standard for proof of causality in science. These different approaches toward proof of causation might be attributable to the fact that the basis of scientific inquiry is the rejection of the null hypothesis that posits that the factors examined are random variables.").

reflection on judicial reasoning of scientific inputs complicated and dynamic, but necessary.

The very existence of uncertainty creates another tension. While there are well-developed areas of law that build on the existence of scientific uncertainty, namely the precautionary principle, when scientific knowledge enters a dispute, the extent of scientific certainty is rarely acknowledged: "It is common knowledge among scientists that scientific uncertainty is inherent to some degree in all scientific results and can never be fully eliminated. Lawyers, however, often do not have a proper understanding of the true nature of scientific uncertainty (Sulyok 2017, p. 529)."

These systems of knowledge are thus structured on different ways of knowing. The forced convergence of the two creates tensions, incongruence, and possibly inconsistent decisions.

3 The Need for Scientific Knowledge in Legal Sustainable Development Narratives

Science and scientific knowledge infiltrate law in both expected and unexpected ways. Environmental law, derived from science, reliant on science, and transforming alongside science, is the most apparent example. However, the role of science has also grown in the context of other regulatory developments and within legal disputes at both the domestic and international level, as the sustainable development narrative has grown in importance. From this perspective, respecting the overlaps and intersections between economics and the environment within the realisation of sustainable development, there is an interrelationship between science and law within the sustainability narrative. This points to a larger change in the aspect of judicial reasoning. Not only are judges and arbitrators confronted with expert reports that rely heavily on scientific language and logic, but those decision makers must interact with those reports and apply them reasonably to the law.

The *Gabčikovo-Nagymaros* dispute can be identified as the most prominent use of scientific fact-finding when deciding a dispute with sustainable development relevance.[21] Respecting their necessary inclusion, but also bowing to their complexity and vulnerability to external factors, the International Court of Justice (ICJ) in the *Gabčikovo-Nagymaros* decision used the scientific inputs as a mechanism for encouraging further negotiations by the parties.[22] Those scientific submissions with respect to the larger structural goal of sustainable development impacted the very process of dispute resolution. The ICJ considered the ongoing environmental impact assessments as a sufficient mechanism for facilitating and encouraging a settlement to the dispute between the parties. Not only was scientific fact-finding relied upon, but it was reverted to as a mechanism by which the parties were to continue negotiation—ultimately with the intention that the dispute would be settled between them based on those scientific findings. Science, therefore, served an instrumental purpose in transforming the way the dispute was framed and how the resolution could be found. In a certain sense, the ICJ's reliance on those findings was a subtle acknowledgement of the limitations of traditional legal decisions in disputes framed around the sustainable development narrative.

In the context of trade law, the disputes that arose in relation to bans on imports of tuna and shrimp caught using fishing techniques that were harmful to other sea life again exposed this reliance on scientific knowledge to come to the

[21] Gabčikovo-Nagymaros Project (Hungary v Slovakia), Judgment, Merits, ICJ GL No 92, [1997] ICJ Rep 7, [1997] ICJ Rep 88, (1998) 37 ILM 162, ICGJ 66 (ICJ 1997), 25 September 1997.

[22] Ibid, paras 140–141 ("The numerous scientific reports which have been presented to the Court by the Parties—even if their conclusions are often contradictory - provide abundant evidence that this impact and these implications are considerable. [. . .] For the purposes of the present case, this means that the Parties together should look afresh at the effects on the environment of the operation of the Gabčikovo power plant. [. . .] It is not for the Court to determine what shall be the final result of these negotiations to be conducted by the Parties. It is for the Parties themselves to find an agreed solution [. . .]").

legally relevant conclusion in the case.[23] In the Appellate Body Report from the *US-Tuna* dispute, it was made clear that the US contended that the Panel had not given sufficient attention to the scientific reports submitted during the dispute.[24] The ultimate conclusion of the dispute, with the implementation of administrative mechanisms to ensure dolphin-safe practices, embodied the scientific conclusions that the measure was unnecessarily targeting only the Eastern Tropical Pacific Ocean whereas there were also established risks to dolphins outside that zone.[25]

As a final example, the tribunals in the *Burlington v Ecuador* and *Perenco v Ecuador* disputes used scientific inputs to justify investor liability under a bilateral investment treaty—a stretch for a system that typically exists only for the purpose of protecting and maintaining a stable foreign investment environment. The use of scientific evidence was key to allowing the counterclaims in both *Burlington v Ecuador*[26] and *Perenco v Ecuador*.[27] While the decisions represent a marked break in the approach to protections in investment law by opening up the possibility of these environmental counterclaims, these closely related claims took differing approaches to the scientific evidence submitted by the parties. The *Burlington* tribunal chose to "see for themselves" the conclusions of the reports and required the experts to translate their conclusions into terms understandable to them and appropriate for their decision-making. The expert scientific submissions on soil and water contamination were examined in a site visit of that contamination with the lawyers, parties, and experts. In *Perenco*, an independent expert was appointed. In this regard, there is a substantial lack of uniformity in managing these scientific inputs. There is limited legal theory on the consequences and implications of this varied interaction with scientific and expert reports.

4 Scientific Turn and Sustainable Development

The cases discussed above corroborate the scientific turn that has already been recognised. This more recent use of science, however, does not manifest significantly differently than it did in the *Trail Smelter* decision. The parties still submit their own expert reports. The conclusions and figures included in those reports often contradict one another. In this turn towards scientific knowledge as part of sustainable development,[28] the

[23] See for example, Panel Report United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/R, 15 September 2011 (US-Tuna II); Arcuri (2017, p. 185) (reflecting on the way the building of scientific evidence of harm to dolphins could be used to assess the timeframe of the non-discrimination claim: "if with the passage of time, scientific evidence emerge and unequivocally point at the fact that other fishing techniques outside the ETP are equally harmful for dolphins, it seems 'WTO-reasonable' to consider the discriminatory character of the measures at the time of the establishment of the Panel.").

[24] Appellate Body Report United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/AB/R, 16 May 2012 (US-Tuna II), paras 27–28, 68.

[25] Appellate Body Report, United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products – Recourse to Article 21.5 of the DSU by the United States, WT/DS381/RW/USA and Add.1 / United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products – Second Recourse to Article 21.5 of the DSU by Mexico (US–Tuna II (Mexico) (Article 21.5 –US) / US–Tuna II (Mexico) (Article 21.5 – Mexico II)), WT/DS381/AB/RW/USA, WT/DS381/AB/RW2, adopted 11 January 2019; see also Baroncini and Brunel (2020, p. 197).

[26] Burlington Resources Inc v Republic of Ecuador, ICSID Case No. ARB/08/5, Decision on Ecuador's Counterclaims, 7 December 2017, para 77.

[27] Perenco Ecuador Ltd v Republic of Ecuador, ICSID Case No. ARB/08/6, Award, 27 September 2019, paras 423 et seq., 489.

[28] For the widespread recognition of the turn to science, see for example, D'Aspremont and Mbengue (2014, p. 240) (noting in particular that "scientific fact-finding is as much a struggle for argumentative persuasiveness as traditional fact-finding and law interpretation"); Gruszczynski (2014) ("Science is used in order to establish necessity, i.e. to show the existence of certain risks and to prove the required relation between a measure and an identified risk"); Ellsworth (2011, p. 895) ("Training to think like a lawyer is not quite like training to think like a scientist, and, more important, the circumstances and constraints faced by lawyers and scientists when they

centrality of that knowledge and its impact on the decision makers is often overlooked. The judges and arbitrators are (typically) not specialised in science, and therefore have limited perspectives on the highly technical, highly relevant scientific submissions. The use of the precautionary principle where the amount of scientific information is not yet fully formed demonstrates a more dynamic relationship with these additional inputs. Katalin Sulyok has already highlighted the limitations to the approach to scientific uncertainty within the European Court of Human Rights.[29] Foster has suggested that the application of facts to the law can be characterised as the rationalist approach (Foster 2011). D'Aspremont and Mbengue (2014, p. 247) ask whether "scientific fact-finding [should] be left exclusively to the judge, should it be made the responsibility of the parties, or should it be outsourced to external experts? Depending on which of these methods of cognition is applied, scientific fact-finding will either resemble traditional law-establishment, come close to traditional fact-finding or grow into a wholly distinct adjudicative operation." Some decades ago, and viewing the issue more specifically through the lens of US law—where the integration of science into criminal law and tort decisions has been well-established—Brewer noted that the judgment of the veracity of a scientific submission is typically deferred to expert scientific witnesses (Brewer 1998, p. 1538). He described the tools applied to give credence to a particular position on a scientific point as being based on a reasoning process but surely not connected to the scientific process itself.[30]

Yet, sustainable development, when applied in a legal context, virtually requires these scientific submissions—these perspectives outside of the law—in order to achieve the objectives of the law or regulatory measure. Scientific knowledge in that context is the material connection between the intention of the law and its application. That materiality is condensed to numbers on a page, graphs, and conclusions. The very reasoning applied and the required outcomes are distinct,[31] creating a difficulty in applying both legal reasoning and scientific reasoning in the same breath of a decision.

With this deference to the expertise of scientists as well as the inherent role of science in creating law,[32] science and the scientists that create it are gaining a new form in the sphere of international law. Beyond judges, scientists are arguably now becoming part of the law-making sphere in international law in the era of sustainable development, and are among the non-state

undertake the task of solving a problem are quite different."); Haack (2009, pp. 14–21).

[29] Sulyok (2017, p. 523) ("By avoiding complex causal inquiries [in toxic exposure case law] and evidentiary assessments, the Strasbourg Court sacrifices predictable and nuanced judicial decision-making and leaves future plaintiffs without guidance as to the court's evidentiary requirements. These shortcomings, if left unaddressed, could undermine the Court's reputation of being a leading advocate of environmental protection based on human rights."); see further, Sulyok (2020).

[30] Brewer (1998, pp. 1538–1539) ("Lacking the information necessary to make cogent independent judgments about which of the competing scientific experts to believe, nonexpert legal decisionmakers choose among the experts by relying on such indicia of expertise as credentials, reputation, and demeanor. Thus, even the act of soliciting and deferring to expert scientific judgment requires nonexperts to use a reasoning process-the process of selecting the experts, deciding which expert to believe when the experts compete, and, finally, deciding how to use the believed expert's information in resolving the central dispute being litigated.").

[31] Ellsworth (2011, p. 913) ("The need to reach final decisions in individual cases also encourages categorical thinking: a defendant is either liable or not liable, sane or insane, a danger to society or not. Scientists, especially social scientists, are more likely to think in terms of continuous variables; there is always a grey area between the sane and the insane, the dangerous and the safe, and the deliberate or unintentional behavior. In dealing with people in these grey areas, the task is to assess the individual and the circumstantial pressures and to come up with an individually nuanced explanation, and if one is a psychiatrist or a clinical psychologist or some other kind of counselor, an individualized plan of treatment. But a judge has to make a decision.").

[32] Avgerinopoulou (2019, p. 345) (providing that "[i]n the [] wake of the twenty-first century, it has become clear that environmental issues require multilateral answers and that science and policy should play a more central role to the policy-making and lawmaking model. Many scholars have argued that science and policy need to be explicitly and effectively interrelated; such interaction is inevitable.")

actors that now colour the system.[33] Chapter 31 of Agenda 21 directly addressed the role of "the scientific and technological community, [...] to make a more open and effective contribution to the decision-making processes concerning environment and development. It is important that the role of science and technology in human affairs be more widely known and better understood, both by decision makers who help determine public policy and by the general public."[34] Their input not only in the creation but in the stage of decision-making through these expert inputs suggests a rich integration.

The interactions of judges with science leads to diverse conclusions regarding how science is either being shunned (Alvarez 2011), or more interestingly, impacting the process of judicial reasoning. This impact of science on judicial reasoning has larger implications within the broader framing of law for a blue planet, suggesting a need for growth and awareness of how that knowledge changes the law generally and the specific impacts of the awareness of the Anthropocene and sustainable development as a legal concept.

5 Conclusion and the Future of Scientific Integration into Law

As science and the law converge, there remains an interaction in the space of legal epistemologies: what materially exists to allow the possibilities of law's future (Brewer 1998, p. 1541)?[35] This interaction is essential in the space and narrative of sustainable development. The question that arises is: How are scientific inputs being applied in the development narrative to achieve the possibilities that lie therein? Have those possibilities been limited by the lack of knowledge of the scientific method by those judges and arbitrators entrusted with applying them and using them for the given ends? Is there a danger of material misuse or misunderstanding resulting in a "just" outcome for the purposes of engaging in the production of a globally-applicable ecologically-sensitive law outside the boundaries of what is in fact provided in such a scientific expert report?

Science as a mechanism for applying sustainable development and respecting the delicate balance between the varying goals of the principle is a necessary addition to legal reasoning and the process of decision-making. The effectiveness of such inputs, however, in a future perspective, requires a different relationship with those inputs. It must be decided at a more systemic level whether and how those inputs should be modifying the process of legal reasoning itself. The outcome in the *Gabčikovo-Nagymaros* dispute of using the ongoing accumulation of scientific information to unburden a decision-making process could have dangerous consequences. The more recent interaction with scientific knowledge, as in the *Burlington* dispute, points to a refreshing re-imagination of how science and law can both be enhanced with the integration.

The inclusion of scientific expertise forces law to push beyond its traditional boundaries—in the way that the inclusion of any expertise pushes a court's analysis beyond a purely legal consideration of facts. Taking science as simply another

[33] Carosso et al. (2019) and Mbengue (2011) (building on the idea of environmental law as formed around an environmental compact that individuals respect and specifically noting that in Section III of Agenda 21, "[n]ot a single major non-state actor is omitted. From women to children, from NGOs to the business sector and from indigenous communities to scientific communities, each component of the 'sustainable development community' is recognized as a key actor.").

[34] United Nations Conference on Environment & Development, Rio de Janerio, Brazil, 3 to 14 June 1992, Agenda 21, Section III.

[35] Brewer notably highlights the *Brown v Board of Education* decision to "illustrate the crucial importance of a court's use of putatively scientific results in reaching and attempting to justify legal decisions." (1542). Emphasising the role of science in decisions of high societal importance, his analysis sets the groundwork for considering how international tribunals similarly use such scientific results to take decisions that impact international development, understood in the holistic environmental, social, and economic contexts.

fact entered into the record is limiting and dishonest to the scientific disciplines as well as the scientific method. This integration calls for a bolder inter-disciplinary interaction that has the potential to improve the realisation of law within the sustainable development narrative. In this movement towards a global legal system respecting the ideal of a blue planet, this integration, understanding and respect is not only necessary but also brings us closer to a post-fragmentary realisation of law that encompasses the realities of the planet.

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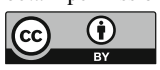

Part II

Climate, Ocean and Biodiversity Protection

Climate Change and Sustainability

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Abstract

The chapter discusses the challenge of global climate change and its relationship with sustainability. Following a brief review of the origin, principal drivers and current situation of climate change, an analysis of recent developments in climate change ethics and climate justice and their influence on climate change global policies is presented. We argue that the heterogeneous global climate movement has captured the world's attention and will probably influence the future course of events. Finally, the chapter addresses the essential role of climate change action in achieving global sustainability and focuses on the interdependency between global inequalities and economic growth. The compatibility of mainstream neoclassical economics (MNE) with the rapid mitigation needed to reach the Paris Agreement temperature goals is discussed. Although far from optimal MNE mitigation policies, world climate change policies are strongly influenced by the global dominance of neoclassical economics.

Keywords

Climate change · Fossil fuels · Climate ethics · Climate justice · Global equity · Mitigation solutions · Sustainable development

1 Fossil Fuels and Social and Economic Progress

Nature's development of a particularly resistant complex organic polymer, lignin, allowed the emergence of the first treelike plants. Trees became robust, some very tall, measuring more than 30 m, and abundant, forming luxuriant marshy forests in the Carboniferous period between 360 and 299 million years ago. These forests sequestered huge amounts of carbon dioxide (CO_2) from the atmosphere. Their fossil remains produced the large coal deposits that fuelled the industrial revolution and still sustain a large part of the world's energy needs. They are known as coal forests (Santos 2012).

At the beginning of the eighteenth century, the consumption of wood to build ships and houses, to meet household demand, and feed the furnaces in foundries and those used to produce bricks and glass began to reduce the forest area in Europe dramatically. The solution was to increase the use of coal, abundant in England and other regions of Central Europe. First, however, the coal mines had to be drained of flood waters before coal could be extracted. The English ironmonger and

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inventor Thomas Newcomen (1664–1729) sought to solve the difficulty, and in 1712 he built a steam-driven machine based on an earlier prototype from 1675 created by Denis Papin (1647–1713), a French physicist and inventor (Santos 2012). The Newcomen steam engine was inefficient, but the problem was successfully solved by James Watt (1736–1819) in 1776.

The 1780s marked the beginning of the fossil fuel era of long-lasting and widespread conversion of the chemical energy stored in coal and other fossil fuels into other forms of energy. Coal provided the primary energy supply for the industrialisation process of the nineteenth century, with global primary energy consumption from coal increasing from 97 TWh in 1800 to 5728 TWh in 1900 (Smil 2016). The history of the intensive exploitation of petroleum began in 1853 with the discovery of a process for distilling kerosene from petroleum by the Polish scientist Ignacy Lukasiewicz. In 1856, the first petroleum refinery began to operate in Pleiesti, Romania, soon followed by many more. In 1859, Edwin Drake, a railway engine driver in New Haven, Connecticut, revolutionised the petroleum industry when he succeeded in extracting petroleum from the subsoil by boring through the rocky layers, near Titusville, in Pennsylvania. Shortly afterward, in 1876, Nikolaus Otto, a German engineer, built and successfully used the first four-stroke internal combustion engine, which was the first competitive alternative to the steam engine. After a few decades, petroleum exploration became commonplace worldwide and oil was used in an increasingly intensive way. Natural gas is a naturally occurring hydrocarbon gas mixture consisting of methane and other alkanes found in natural gas fields or associated with oil fields and coal beds. In the nineteenth century, natural gas was used mostly as a source of light. Still in the twentieth century, once efficient pipelines had begun to be built, it was also used for domestic heating and cooking, to generate electricity and in industry.

The intensive use of fossil fuels was an essential driver in constructing the current global development model. This has improved average human economic prosperity at the global level, especially in the last two centuries (Santos 2021), although it has not solved the deepening North-South socioeconomic divide. The availability of an affordable and abundant form of energy associated with socioeconomic, scientific, and technological advances contributed to the rapid improvement of public health, an increase in fertility, and a remarkable extension of life expectancy, leading to a 7.8-fold increase in the global population from 1800 to 2019. The other outstanding feature of the processes initiated by the Industrial Revolution was sustained exponential global economic growth for more than two centuries, which allowed a 33-fold increase in global GDP per capita from 1820 to 2006 (Jones 2016). Global primary energy consumption increased from 20 EJ in 1800 to 584 EJ in 2019 (BP 2020), representing a 3.7-fold increase in primary energy consumption per capita.

In the nineteenth century, science predicted that CO_2 emissions from fossil fuel combustion would cause an increase in the atmosphere's mean global temperature. During the twentieth century global climate change was identified and attributed to anthropogenic greenhouse gas (GHG) emissions, especially CO_2. According to the last report of the Intergovernmental Panel on Climate Change (IPCC), "observed increases in well-mixed GHG concentrations since around 1750 are unequivocally caused by human activities" (IPCC 2021). The atmospheric concentrations of CO_2, Methane (CH_4) and nitrous oxide (N_2O) in 2021, were 415.7±0.2 ppm, 1908±2 ppb, and 334.5±0.1 ppb, respectively, representing 149%, 262% and 124% of pre-industrial levels (before 1750). (WMO 2022). Since the establishment of the IPCC in 1988, the share of fossil fuel primary energy supply has remained almost unchanged between 1990–2020 at around 81% (Pedersen et al. 2021; IEA 2021). Although electric power generation from renewable energies reached 27% in 2019 and is fast increasing, there is no evidence yet of a sustained global energy transition to renewables, since fossil and renewable energy production increases at similar speeds (Pedersen et al. 2021). Such a transition will need to take place before 2050, requiring global annual

reductions of 1–2 $GtCO_2$ in CO_2 emissions throughout the 2020s and beyond, to achieve the Paris Agreement[1] goal of holding the increase in global mean surface temperature (GMST) below 2 °C, and pursuing efforts to limit the temperature increase to 1.5 °C (Le Quéré et al. 2021), relative to pre-industrial times (1850–1900) (IPCC 2021). A pathway with no or limited overshoot of the 1.5 °C Paris goal requires global GHG emissions to fall by about 45% by 2030 compared to 2010, reaching net zero around 2050 (IPCC 2018). Limiting the GMST rise to below 2 °C requires CO_2 emissions to decrease by about 25% from 2010 to 2030 and reach net zero around 2070 (UNFCCC 2021). These results show that rapid global decarbonisation is now mandatory to achieve the Paris goals.

The Earth's GMST has *increased* by around 1.1 °C compared to the average *for* the 1850–1900 period. The largest part of this increase (2/3) has occurred since 1975 at a rate of about 0.15–0.2 °C per decade (Hansen et al. 2010). Cumulative CO_2 emissions from fossil fuels and industrial production in the period 1850–2019 have amounted to 1640 $GtCO_2$, rising from 0.85 $GtCO_2$ to 36.5 $GtCO_2$ in 2019 (GCP 2020). Thus, the mitigation challenge and urgency are mounting (Peters et al. 2020). Since the Paris Agreement,[2] emissions have continued to increase every year. Only the measures taken worldwide to combat the COVID-19 pandemic crisis caused an estimated temporary 5.6% drop in CO_2 emissions (Le Quéré et al. 2020) and a 5% drop in total GHG emissions measured in carbon dioxide equivalents (CO_2e) (Becker et al. 2020). This is the largest annual reduction ever observed (Le Quéré et al. 2021).

2 Climate Change Ethics and Justice

Climate change has been a very fertile subject for ethics since the beginning of the 1990s (Jamieson 1992; Gardiner 2006; Arnold 2010; Gardiner 2011; Caney 2014, 2016). Climate change is viewed as an intragenerational and intergenerational global problem that may be solved by the application of universal theoretical ethical principles to positively influence and promote real-world responses. Those principles are discussed within the UNFCCC, partly reflected in the Paris Agreement (UNFCCC/COP 2015; Okereke and Coventry 2016) and agreements taken in follow-up COPs (UNFCCC/COP 2022). Justice principles generally seek to address the asymmetries between individuals in developing and developed countries and also between individuals inside each country, as regards personal contributions and institutional responsibilities in GHG emissions and in the capacity to reduce these emissions. A second type of asymmetry is connected with different degrees of vulnerability to the impacts of climate change. Generally, people living in developing countries, and especially in the least developed countries and in fragile states (OECD 2018), are more vulnerable and have a much lower capacity to cope with the damaging impacts of more frequent extreme weather events attributable to climate change, and to changes in precipitation regimes and the global average sea level rise, than people living in the advanced economies. Furthermore, in communities around the world, especially in developing countries, poor people and in particular women are more vulnerable to the harmful impacts of climate change (Nellemann et al. 2011). Finally, there is a third asymmetry caused by the delay in controlling the cause of a slowly evolving process. The GHG emissions produced by the current generation are exacerbating a problem that is already growing and are making it more harmful for future generations. These asymmetries tend to increase poverty, malnutrition, hunger, health risks and forced migrations in more vulnerable populations. Here we will address questions related to climate ethics and the emerging field of climate justice, although leaving aside those concerning the moral status of climate change denial (Gremmen 2012; Lavik 2015).

Ideally, a normative theory of climate change ethics could be very relevant in deciding how to distribute investment between mitigation and

[1] Paris Agreement 2015 (United Nations Framework Convention on Climate Change).

[2] Paris Agreement.

adaptation, how to correctly balance the costs and benefits of mitigation measures, and how to distribute the costs and non-climate benefits of decarbonisation. It could also help in achieving a just transition from a fossil-fuel-based global economy to one powered by renewable energies. However, after more than 25 years of philosophical analyses in ethical normative theory, climate change risks continue to increase (Santos 2020), and the energy transition is still in its infancy. Faced with the increasing evidence that climate politics has a "difficult, problematic, or perhaps wicked" specific character (Brandstedt 2019), climate ethicists have tried to be more practical and to seek pragmatic ways to bring individual people, and eventually society, closer to normative ethical ideals. This emerging approach, known as non-ideal theory, specifically addresses the question of realism, which implies starting from an accurate description of people, politics and policies, transitional processes, concerns, and ways of dealing with non-compliers (Heyward and Roser 2016).

One critical aspect of the non-ideal theoretical approach of bringing individuals and society closer to normative ethical ideals is to identify agents of change, who are willing to pursue changes that would reduce injustices resulting from climate change (Laurence 2020). An agent of change is an agent willing or potentially willing to pursue actions to address and help resolve significant injustices. An additional problem is to decide on ethical grounds what importance should be given to agents who cause injustice and are often politically mobilised to defend the existing state of affairs, regarding social or political climate change issues, such as governments, political parties, and corporations. What ethical attitude should be recommended for climate deniers who endorse the narrative developed by the fossil fuel industry since the 1980s that acting decisively to reduce emissions of GHG will have a devastating effect on jobs and the economy as a whole? (Collomb 2014) A third issue in non-ideal theoretical analysis concerns the extent to which agents of change are free to move successfully towards normative ethical ideals or are constrained by the overarching economic system that supports and empowers them, in which case the agent of change has to become the system itself (Somerville 2020). According to Brandstedt "even non-ideal climate justice may be too disconnected from the fast-moving and messy climate circus" (Brandstedt 2019). More recently it has been suggested that "engaged methods" that involve substantial interaction between the theorist and actual or potential agents of change ought to be used to influence real-world climate action (Green and Brandstedt 2021).

Climate justice comes in three main forms: academic discourse, a motivational ideal of non-governmental organisations, and social and political grassroots movements concerned with questions of human rights and social, distributive, and intergenerational justice related to or caused by climate change. Grassroots climate justice and climate action movements are a form of climate activism that originated in the concepts and movements of environmental justice that began to appear in society in the 1990s (Schlosberg 2014). The Environmental Justice and Climate Change Initiative was founded in 2001, during the first Climate Justice Summit at the COP6 meeting of the United Nations Framework Convention on Climate Change (UNFCCC) in The Hague.

There is a certain disconnection between non-ideal ethical theories of climate change and their applications and the grassroots movements of climate justice, although the ideals and interests of both frequently overlap. They have so far represented two complementary approaches to address the challenge of climate change, each functioning in its own domain with few cross-references and little collaboration (Schlosberg 2014). However, this situation appears to be changing. A wide range of climate justice and climate action movements and individual climate change activists have been able to develop and establish what have been called anti-fossil fuel norms (Green 2018; Blondeel et al. 2021), such as discontinuing fossil fuel subsidies, promoting fossil fuel divestments, phasing out coal power stations and coal mining investments, discontinuing oil and gas fracking, phasing out the use of oil and natural gas, and more generally

establishing a moratorium on prospection for fossil fuels. Anti-fossil fuel norms have been advocated in more or less explicit ways by individuals and organisations in civil society, international organisations such as the IMF (Herbst-Bayliss 2016), the World Bank (King 2014), the OECD (Gurría 2015), and state leaders (Green 2018). The leader of the Catholic religion, Pope Francis, who also implicitly endorsed some of these norms (Francis 2015), was promptly rebuked by defenders of mainstream neoclassical economics (Nordhaus 2015; Rocca 2015). Francis Rocca of The Wall Street Journal commented that Pope Francis "offered a broad and uncompromising indictment of the global market economy, accusing it of plundering the Earth at the expense of the poor and of future generations" (Rocca 2015).

Recently, a growing number of young climate activists have been expressing their dissent regarding current global climate change policies and business-as-usual economic and social policies, including their undisputable emphasis on support for unlimited economic growth (Escobar 2015; Marris 2019). In the complex reality of youth concerns about climate change, O'Brien et al. (2018). have identified three types of dissent: dutiful, disruptive, and dangerous. This heterogeneous global climate movement has captured the world's attention, is becoming more powerful, and will likely be able to influence the future course of events. Part of its strength lies in the fact that the young activists do not represent someone else's agenda. Furthermore, the young protesters do not yet have vested interests, other than their existential interest in protecting their future lives and well-being. In fact, the risks and uncertainties of not holding the GMST increase to 1.5 °C above pre-industrial levels are disproportionally higher for them and for the generations to come (Thiery et al. 2021).

It remains to be seen whether the movements that defend anti-fossil fuel norms are able to influence societies worldwide and contribute to accelerating global decarbonisation. The adoption of anti-fossil fuel norms could become a rapidly spreading form of social behaviour in some democratic countries.

3 Climate Change and Sustainability. Inequalities and Economics as Critical Points

In 1983, the World Commission on the Environment and Development, chaired by Gro Harlem Brundtland, defined sustainable development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". It gradually became clear that sustainable development is not a strictly scientific concept that can be defined unambiguously, since opinions differ as to precisely which human needs should be considered for application of the principle of intergenerational equity (Santos 2012). These needs can be categorised as falling within social, environmental, cultural and economic realms, but the relative importance of the different components is a matter of opinion.

Sustainability is a state of living that is able to continue for a long period and can be applied to all living systems, including the human system. It is a broader concept than sustainable development, which is implicitly more focused on a strategy for human development. Both concepts are very recent in the history of civilizations and what makes them distinctive is their emphasis on the future, which can be interpreted as a form of uneasiness about the future of mankind. Expressive proof of this concern was provided in 2015, when 193 countries of the UN General Assembly adopted the 2030 Development Agenda, with 17 Sustainable Development Goals (SDG) and the 169 targets and 232 indicators associated with these. Most of the SDGs are interconnected and interdependent, SDG 13—Climate Action—being a leading example. Here we shall focus on the interdependency between SDG 13 and SDGs 8 and 10.

Most people would agree with Indira Gandhi when, in her speech to the UN Conference on

Environment in Stockholm in 1972, she posed the question: *Are not poverty and need the greatest polluters?* It is impossible to achieve sustainable development without eradicating or greatly reducing various acute forms of inequality: extreme poverty, hunger and food insecurity, long-term unemployment and income inequalities within and between countries. Inequalities in human development impede a successful response to climate change, and help to reinforce it. The solution to each problem is dependent on the solution to the other. It is highly unlikely that climate justice can be restored with the current level of inequalities across the world. Furthermore, it is unlikely that the GMST goals of the Paris Agreement can be reached without substantially increasing support for climate change mitigation from OECD countries to their non-OECD counterparts. There are various other examples of inextricably bound sustainability problems but discussion of these is beyond the scope of this chapter.

It has been argued that it is difficult for mainstream neoclassical economics (MNE) to promote effective mitigation at the global level (Klein 2015). Many have voiced the opinion that the neoclassical economic system has failed to respond fast enough to the challenge of climate change, and there are examples where it has impeded effective action (Turner 2019). Nevertheless, neoclassical economics provides the tools needed to address the problem. Why has it been unsuccessful up to now? The answer to this question lies at the core of sustainability in the current and next centuries, and is briefly analysed here, from the point of view of MNE.

There is consensus that rapid global mitigation is disruptive for many economic activities, with some industries and businesses gaining value and flourishing while others shrink and tend to disappear, which generates social and economic costs and losses for groups of people and countries. It may be possible to reach agreement on how to implement a just and equitable transition to a global low-carbon economy using the most appropriate transitional assistance policies for each region and country (Green and Brandstedt 2021), but the transition has been, and continues to be, constrained by the overarching global role of MNE.

Neoclassical economic theory acknowledges the over-exploitation of natural resources, pollution, increasing GHG emissions, waste accumulation, and environmental degradation as market failures that can be corrected by internalising the cost of negative externalities through appropriate market correction measures. In the case of climate change, the market correction is to establish a price attached to GHG emissions so that the cost of emissions is borne by the emitter. All countries, or initially a *climate club* of countries (Nordhaus 1992), should use, in all sectors of the economy, a carbon tax or a cap-and-trade mechanism, as applied in the European Union, or indeed both methods, to put a price on carbon. The economic cost-benefit optimisation models that use mitigation as a market correction tool based on a carbon price were developed about 30 years ago and have been regularly updated by William Nordhaus (Nordhaus 1992, 1993, 2013, 2017, 2018), but their effective application in global climate governance[3] and national policymaking[4] to mitigate and 'control' climate change has had limited success so far.

The climate change challenge is particularly difficult to address from the point of view of neoclassical economics, for three main reasons. First, it requires intertemporal decisions involving time periods much longer than one or two social generations, while the main objective of the theory of economic growth (Solow 1956; Swan 1956) is to maximise economic growth, measured as GDP, over periods of 50–60 years, or shorter. This objective is succinctly expressed by Joseph Stiglitz when he writes that analytic growth models "*are intended to help us answer questions like, for the intermediate run—for the next 50–60 years, is it possible that growth can be*

[3] Glasgow Climate Pact 2021 (Decision-/CP26) UNFCCC (2021).

[4] Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people 2020 (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions) (The White House 2021).

sustained? What does this possibility entail? We write down models as if they extend out to infinity, but no one takes these limits seriously" (Stiglitz 1997). However, some of the activities in the human subsystem over a period of 50–60 years interfere with the Earth system for many centuries and generate impacts on the human subsystem that should not be ignored. A paradigmatic example is anthropogenic GHG emissions that have had impacts on the human-climate system over the last two centuries that will be felt for many centuries and possibly millennia, periods of time which for human hyperbolic time discounting are virtually irrelevant (Ainslie 2001). What humans do now, how they live, and the characteristics of their technosphere in the current intermediate run, have impacts on the climate system well beyond that run, and these impacts will affect the human subsystem in intermediate runs in the very distant future. In the intertemporal decisions recommended by cost-benefit optimisation models (Nordhaus 2017, 2018), the critical point is to assume that the future is a series of successive intermediate runs of economic growth. The reason for favouring the intermediate run rather than the long run stems from the fact that the operative social time of the contemporary generation is strongly focused on its own element of operative time. The spaces of experience and horizons of expectation of future generations are barely relevant because they go beyond the operative time of the contemporary social generation (Santos 2021).

There is a second, more specific difficulty with MNE in dealing with long-term intertemporal decisions, although it relates to the previous one. Climate change market-based mitigation policies are especially sensitive to the value chosen for the social time discount rate used for investing in mitigation, a choice that has generated well-known debates (Nordhaus 2007; Stern 2007). A high discount rate, as advocated by Nordhaus, implies that it is not advisable to mitigate climate change rapidly because that would involve a very high social cost of carbon, which would slow global GDP growth. A cost-benefit analysis under the assumption of continuous and robust GDP growth shows that there is no need for rapid mitigation since future generations will be empowered with better technology to deal with the problem of climate change. A low discount rate, as advocated by Stern (2007), is favoured by ethical considerations of intergenerational justice based on the severity of the future impacts of unmitigated climate change, especially in the most vulnerable countries.

The third difficulty in the MNE approach is that mitigation is related to climate justice through the recognition that climate change has different impacts in populations with vastly different socioeconomic development levels, and in particular puts human rights at risk for poor and vulnerable people (Olawuyi 2015). Current negative climate change impacts are on average more severe in lower- and middle-income countries than in higher-income countries, in terms of loss of lives and livelihoods. In the former group of countries, there tend to be more profound negative effects on human rights, including rights to life, development, food, health, water and sanitation, and housing. This disparity in the impacts on human rights is not captured by mitigation models based on a cost-benefit economic optimum. In other words, in a poor and vulnerable population, the economic losses measured in terms of GDP may be low but the loss in human rights and environmental degradation may be high. Using the Global Progress Indicator (GPI) (Kubiszewski et al. 2013), which is used in ecological economics and takes into account both environmental and social factors, rather than GDP, would lead to a different final result.

Each country is a special case as regards the energy transition, so the effect of putting a price on carbon depends on the endogenous energy sources, the energy system, the growth rate of energy demand, the transition process and the level of socioeconomic development. However, all countries are committed to the same global model of GDP growth, believed to lead necessarily to increased economic prosperity and well-being in the foreseeable future. Carbon pricing is likely to slow down a country's GDP growth and its sustainability and competitiveness in the global economy in the short term. Governments, especially in OECD countries, frequently prefer

to use regulation and administrative measures to decarbonise the economy, instead of a carbon tax, because the cost of such measures is less transparent to society and it therefore becomes unclear which voters will be more affected by the process (Luciani 2020). The introduction of a uniform CO_2 price on all emissions in a world economy based on intensive energy use, where 81% of the primary energy sources in 2019 were fossil fuels (IEA 2021), would necessarily reduce global GDP. In any case, rapid decarbonisation requires an increased level of state intervention in macroeconomics, which is unwelcome in neoclassical economics.

Knowledge of the beneficial effects of mitigation, especially in the long term for future generations, has been insufficient to move the electorates in OECD countries towards strong decarbonisation policies. In addition, global mitigation has not yet been sufficiently supported by the developed Annex1 countries,[5] as inscribed in the Paris Agreement from 2020 and onwards.[6] Recently, damage resulting from impacts attributed to climate change, especially damage related to extreme weather events, has caught the attention of society and governments in OECD countries, emphasising the need for rapid adaptation and mitigation action. Furthermore, there are emerging signs that uncontrolled climate change is already creating risks for economic growth in some countries (Kiley 2021). Rapid mitigation is more difficult in emerging and developing economies, such as the major emitters China and India, since their priority is to advance their development agenda and reach the same level of GDP, economic prosperity, and well-being as the OECD countries (Bhardwaj et al. 2018; Jinping 2020; Choudhury 2021).

The current point of view of neoclassical economics is that up to now nations have adopted minimal mitigation policies and that only alternative climate policies based on optimised growth theory models can successfully address the problem (Nordhaus 2018). Reaching the international temperature target of 2 °C with current policies is not considered to be feasible with reasonably accessible technologies, even with very ambitious mitigation strategies (Nordhaus 2018). The cost-benefit economic optimum, which optimises global climate mitigation policy using the DICE model, projects that the GMST will reach about 3.5 °C in 2100 and continue to increase in the twenty-second century (Nordhaus 2018). This result is heavily dependent on when implementation of the optimised mitigation policy begins. If the optimal cost-benefit pathway is delayed by 20 to 30 years the GMST increase in 2100 will be 4 °C or more. It remains to be seen whether world climate policy will end up following the 3.5 °C trajectory or stay below the Paris Agreement temperature targets. If the former happens, this can be interpreted as substantiation of the constraints imposed by neoclassical economics in the search for a solution to the climate change problem.

In conclusion, there is a great distance between current world climate change policies and optimal MNE global mitigation policies that are supposed to effectively address the climate change challenge, yet the former are strongly influenced by the overwhelming global dominance of neoclassical economics.

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[5] Glasgow Climate Pact, November 2021.

[6] Paris Agreement, December 2015.

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Pollution and Law

Manuela Pintado and Alexandra Aragão

Abstract

Pollution law is the result of decades of legislative evolution in environmental law. The inherent complexity of pollution has legal consequences. Pollution norms are not compiled into one single harmonised pollution law and much less a "pollution code". This makes it much harder to know, interpret, apply, monitor and implement pollution laws, and to apply sanctions to the violations of those laws. The final reason that explains and justifies efforts to regulate, tax, charge for, clean up, supervise and sanction pollution is protection of the victims of pollution. Intensive linear economic activity, which ignores the limits of the environment and the resulting long-term damage, is depleting the planet's resources. It is therefore crucial to implement strategies and solutions that enable pollution prevention and that maximise the value of resources. Pollution prevention must be proactive and needs a pre-planned strategy. Current and future generations deserve a pollution-free world. Pollution is a battle that can be won.

Keywords

Pollution law · Pollution costs · Prevention · Precaution · Polluter pays · Circular economy

1 Pollution and Pollution Law

Pollution can take a number of forms. The legal regime governing pollution is flexible enough to include the various forms of pollution. Historically, laws began by regulating classical chemical pollution that contaminated air, water, soil or living organisms. Currently, other more subtle forms of pollution, such as electromagnetic radiation, thermal pollution or nano pollution, are also regulated by law.

In this context, the legal regime for industrial pollution, known as "integrated pollution prevention and control" or IPPC, defines 'emission' as "the direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into air, water or land".[1]

Furthermore, nowadays legal norms consider not only the impacts of pollution in the direct vicinity of the polluting installation or activity,

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[1] Article 3 of Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

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but also long-distance pollution[2] and even extra atmospheric space pollution.[3]

From an economic point of view, according to economic theory, pollution is an *externality* caused by a market failure (Marshall 1890; Coase 1960). As will be explained, the polluter pays principle is the perfect instrument to impose internalisation of pollution costs.

2 Legal Approaches and Regulation of Pollution

Pollution law is the result of decades of legislative evolution in environmental law. Considering their scope of application and the legislative approach, existing environmental norms can be divided into two major categories: green environmental law and grey environmental law.

Green environmental law deals with the conservation of natural areas, including habitats and species. It can be regarded as a synonym for biodiversity law. At the international level, one example is the 1992 UN Convention on biodiversity.[4] In the European Union, it mainly equates to the *Natura 2000* directive,[5] which creates the largest network of nature conservation sites in the world.

Grey environmental law describes the large number of legal rules developed to combat different forms of environmental degradation, mostly caused by emissions of chemical substances, ionising radiation, light, noise and waste. Grey environment law is broadly synonymous with pollution law. The most prominent examples at the international level are the Convention on long-range transboundary air pollution[6] (Geneva, 13 November 1979), and the Convention on the protection and use of transboundary watercourses and international lakes[7] (Helsinki, 17 March 1992), relating to atmospheric pollution and water pollution, respectively. In Europe, one key example is the industrial emissions directive, also called the *integrated pollution prevention and control rules* (European Union 2010).

Institutionally there has been a parallel development of institutions oriented towards green or grey environmental laws. For example, the Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 to deal with atmospheric pollution caused by greenhouse gases (IPCC 2021) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2019), was set up in 2012, to strengthen the science-policy interface for biodiversity and ecosystem services. The work of these specialised hybrid organs, composed of government representatives, scientists and associations, is fundamental for the evolution of green and grey laws.

Grey environmental law has expanded along two lines of development. Firstly, it has increased the types of pollution regulated by law: from the obvious initial cases of air,[8] water (European Community 2000) or noise pollution, to less

[2] 1979 Geneva Convention on Long-Range Transboundary Air Pollution (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:21979A1113%2801%29).

[3] The United Nations Committee on the Peaceful Uses of Outer Space adopted a set of Space Debris Mitigation Guidelines which were later endorsed by the General Assembly in 2007. (https://www.unoosa.org/oosa/documents-and-resolutions/search.jspx?view=documents&match=ST/SPACE/49).

[4] https://www.cbd.int/doc/legal/cbd-en.pdf.

[5] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043.

[6] https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-1&chapter=27&clang=_en.

[7] https://unece.org/environment-policy/water.

[8] Directive 75/439/EEC on waste oils is a historic European Community Directive that marked the start of the European Community's environmental policy. It imposed a duty on waste producers to reuse or recycle waste oils instead of discarding or destroying them. The Association of Waste Incinerators in France questioned the validity of the Directive in a French Court. In a landmark preliminary ruling procedure the European Court of Justice upheld the interpretation that the Directive was valid and that it established a proportional protection of an emerging European value: environmental quality as a *sine qua non* condition for the quality of life (Case 240/83 Judgment of the Court of 7 February 1985) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A61983CJ0240).

visible yet equally dangerous forms of pollution, for instance, radioactive pollution, persistent organic pollutants, heavy metals or pollution caused by nanomaterials.

Pollution appears in a wide variety of forms, coming from different pollution sources, emitting heterogeneous pollution substances, affecting a diversity of receiving media, and causing a profusion of environmental victims.

This inherent complexity of pollution has legal consequences. Pollution norms are not compiled into one single harmonised pollution law and much less a "pollution code". This makes it much harder to know, interpret, apply, monitor and implement pollution laws, and to apply sanctions to the violations of those laws.

Pollution law is classified differently according to the regulatory approach adopted: it can be organised by the receiving media (atmospheric pollution law,[9] water pollution law[10]) or by the polluting vector (greenhouse gas pollution,[11] persistent organic pollutants,[12] mercury pollution[13]) or by the source of pollution (industrial emissions,[14] emissions from motor vehicles[15]).

3 Legal Principles Applicable to Pollution

The legal regulation of pollution is inspired by environmental principles (De Sadeleer 2020). The main principles shaping pollution laws are prevention, precaution, correction at the source and the polluter pays.

These principles have formally been part of the European Treaties since 1986. Currently they are incorporated in Article 191 (2) of the Treaty on the Functioning of the European Union:

> 2. Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay

Besides these core principles established in the Treaty, it is also very relevant to consider the transparency principle and the right of access to information.

3.1 Relevance of the Principles

The reason why environmental principles tend to induce adhesion and generate consensus is because they are the legal translation of intuitive rules of common sense, efficiency and fairness.

Moreover, the principles are binding not only on the EU institutions but also on the Member States, who are obliged to pursue "sincere cooperation" with the EU to "ensure fulfilment of the obligations arising out of the Treaties or resulting from the acts of the institutions of the Union".[16]

More importantly, in EU law the principles are applicable to pollution arising from a wide range of policies and activities. As a result of the integration principle, the European Institutions and the Member States are obliged to consider the

[9] Long range transboundary https://unece.org/convention-and-its-achievements.

[10] Article 194 and 195 of the International Convention on the Law of the Sea https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm.

[11] 1992 UN Framework Convention on Climate (https://unfccc.int/resource/docs/convkp/conveng.pdf).

[12] Stockholm Convention (http://www.pops.int/).

[13] https://www.mercuryconvention.org/en.

[14] EU Industrial Emissions Directive https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075.

[15] REGULATION (EU) No 540/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the sound level of motor vehicles https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex%3A32014R0540.

[16] Article 4(3) of the Treaty on the European Union: "Pursuant to the principle of sincere cooperation, the Union and the Member States shall, in full mutual respect, assist each other in carrying out tasks which flow from the Treaties. The Member States shall take any appropriate measure, general or particular, to ensure fulfilment of the obligations arising out of the Treaties or resulting from the acts of the institutions of the Union. The Member States shall facilitate the achievement of the Union's tasks and refrain from any measure which could jeopardise the attainment of the Union's objectives".

environmental principles when acting in all the competence domains and in every EU policy field: "environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development" (Article 11 of the Treaty on the Functioning of the European Union). Hence, industry, agriculture, fisheries, forestry, mining, energy, transport, tourism, health, scientific research, space, defence, security, taxes, cohesion, consumption or cooperation with third countries are just some examples of policies that must deal with pollution, taking into account the fundamental principles of environmental law.

The application of these principles to pollution law is illustrated by the European Directive that deals with the most classic case of pollution: European Directive 2010/75/EU,[17] which establishes the industrial emissions regime. In fact, industrial pollution gives rise to the vast majority of typical pollution conflicts involving multiple parties: the operator, the neighbours, the workers, non-governmental organisations and the public authorities are some of the interested parties and stakeholders. Industrial pollution also provides a good illustration since the dilemmas of tolerating or proscribing a polluting industrial activity[18] have been addressed at different levels, from courts of human rights[19] to initiatives by national administrations supported by the European Union, such as Impel,[20] which produced a *neighbourhood dialogue toolkit* to support national administrations facing public opposition and demonstrations against proposed investments at the local level.[21]

3.2 Transparency Principle

Transparency and access to environmental information are now central values in EU environmental law. Directive 2003/4/EC of the European Parliament and of the Council, of 28 January 2003, on public access to environmental information establishes the right of access of any applicant (at his request and without his having to state an interest) to environmental information held by public authorities (Article 3 (1)).

For the purposes of the Directive 'Environmental information' includes both pollution and pollution sources. According to Article 2 (1) 'Environmental information' means "any information in written, visual, aural, electronic or any other material form on (. . .) (a) the state of the elements of the environment, such as air and atmosphere, water, soil, land, landscape and natural sites including wetlands, coastal and marine areas, biological diversity and its components, including genetically modified organisms, and the interaction among these elements; (b) factors, such as substances, energy, noise, radiation or waste, including radioactive waste, emissions, discharges and other releases into the environment, affecting or likely to affect the elements of the environment referred to in (a);

[17] Directive of the European Parliament and of the Council of 24 November 2010 on industrial emissions https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32010L0075.

[18] Job creation, investment attraction, increasing production scale and widening of the market for products and services are some of the benefits usually associated with industrial development.

[19] European Court of Human Rights, Fadeyeva vs. Russia, no. 55723/00, 9 June 2005, steel industry; Băcilă vs. Romenia, no. 19234/04, 30 March 2010, smelting industry; Cordella and others vs. Italy, no. 54414/13 and 54264/15, 24 January 2019 smelting industry.

[20] The European Union Network for the Implementation and Enforcement of Environmental Law is an international non-profit association of the environmental authorities of the European Union Member States and a few other European countries. The Network's objective is to create the necessary impetus in the European Union to make progress on ensuring a more effective application of environmental legislation (https://www.impel.eu/).

[21] The *neighbourhood dialogue toolkit* is aimed at authorities and companies who want to use or promote a direct dialogue approach to solving environmental conflicts between residents and industrial sites. A number of Member States have been involved in a series of projects on establishing neighbourhood dialogues, which collected and evaluated examples of how environmental conflicts between companies and their neighbourhoods could be solved by dialogue (https://www.impel.eu/tools/neighbourhood-dialogue-toolkit/).

(f) the state of human health and safety, including the contamination of the food chain, where relevant, conditions of human life, cultural sites and built structures inasmuch as they are or may be affected by the state of the elements of the environment referred to in (a) or, through those elements, by any of the matters referred to in (b) and (c).

Furthermore, "public authorities must organise the environmental information which is relevant to their functions (. . .) with a view to its active and systematic dissemination to the public, in particular by means of computer telecommunication and/or electronic technology, where available" (Article 7, on dissemination of environmental information).

However, there are other cases of transparency regarding pollution. The norms on disclosure of non-financial and diversity information by certain large undertakings and groups (European Union 2014) impose corporate social and environmental responsibility requirements, in order to promote sustainable development through accountable, transparent and responsible business behaviour. The 2014 European regime obliges large companies to reveal the risks they pose to the environment, their employees and society, as well as the policies pursued and the outcome of those policies, demonstrated by relevant key performance indicators (Preamble, §7 "where undertakings are required to prepare a non-financial statement, that statement should contain, as regards environmental matters, details of the current and foreseeable impacts of the undertaking's operations on the environment, and, as appropriate, on health and safety, the use of renewable and/or non-renewable energy, greenhouse gas emissions, water use and air pollution").

3.3 Prevention Principle

The prevention principle highlights the duty, above all, to avoid pollution (De Sadeleer 1999). The effort required from the polluter is to invest whatever is necessary to make sure that pollution is not emitted at all, rather than investing in repairing damage caused by its emission. This can be done by changing the materials, reagents or other substances used in production, by transforming the way materials are extracted, transported or transformed into products or services, or by altering the way products or services are delivered, used or discarded.

In a linear economy, pollution can happen at every step of the production-consumption-disposal chain.[22]

Article 11 of the EU's Industrial Emissions (Integrated Pollution Prevention And Control) Directive is an example of how the law imposes prevention duties on polluters. Setting out the general principles governing the basic obligations of operators, this article provides as follows:

> Member States shall take the necessary measures to provide that installations are operated in accordance with the following principles:
> (a) all the appropriate preventive measures are taken against pollution;
> (b) the best available techniques are applied;
> (c) no significant pollution is caused;[23]
> (d) the generation of waste is prevented in accordance with Directive 2008/98/EC;
> (e) where waste is generated, it is, in order of priority and in accordance with Directive 2008/98/EC, prepared for re-use, recycled, recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment;
> (f) energy is used efficiently;
> (g) the necessary measures are taken to prevent accidents and limit their consequences;
> (h) the necessary measures are taken upon definitive cessation of activities to avoid any risk of pollution and return the site of operation to the satisfactory state defined in accordance with Article 22.

Implementation of the prevention principle gives rise to a number of questions regarding the level of preventive investment that is required of the polluter. How much effort, both financial and in terms of human resources, is the polluter required to make? The answer is provided by the proportionality principle, which stresses that

[22] The reality is quite different in a circular economy, as will be explained later.

[23] On the interpretation of the "do no significant harm" clause, see European Commission (2021a).

there must be a balance between the benefits and the costs of pollution prevention. Recognising the difficulty of comparing long-term environmental improvement and health benefits, on one hand, with short-term economic costs, on the other, some authors prefer to speak of eco-proportionality (Winter 2018). Eco-proportionality seems to indicate that the fictional conversion of long-term immaterial benefits into economic savings is neither mandatory nor advisable. For instance, the health benefits of pollution prevention can be expressed by avoided hospital costs or unused medicines. For the sake of comparability, this is one possible way, but it is surely a reductionist approach. There are numerous other advantages to not falling ill besides saving on medicines or other hospital costs. On the other hand, considering that pollution prevention often enables economic savings, eco-proportionality presupposes that preference should always be given to preventive solutions, except in cases where social costs add to the economic costs. This is the thinking behind the fair, green and digital transitions driven by the European green deal and supported by the Just Transition Fund in the EU.[24]

3.4 Precautionary Principle

Quite differently, the precautionary principle advocates a cautious approach to pollution in cases of uncertainty (Fisher et al. 2006). In fact, in many cases the need to adopt avoidance measures is not obvious. This uncertainty can arise when the source of the pollution is not clearly determined. One example would be water contamination appearing in a river, where several industries have discharge permits upstream and inspections to establish responsibilities are still pending. Another case is when the consequences of certain activities are uncertain, for instance the consequences of waste incineration when the composition of the waste is unknown. Finally, there may also be uncertainty when the chain of causation has not yet been proven. Here we may see the example of neighbours who have reported health issues associated with exposure to electro smog, although the connection between their symptoms and the electromagnetic fields has not yet been scientifically confirmed.

These are some examples of where the precautionary principle is useful, eradicating decisionmakers' inertia and imposing the adoption of safety measures to avert unproven risks. In practice, precaution means the burden of proof lies with the potential polluter to demonstrate that a certain activity, substance, technology or procedure does not pose a risk of serious pollution. All the while he is unable to prove that his activity, substance, technology or procedure is innocuous, he is required to adopt protective measures to adequately prevent any potential pollution.

In EU Law, Article 59 (2) and (3) of the Industrial Emissions Directive (on control of emissions) refer to the duty of the operator of the installation to demonstrate that the emission limit value for fugitive emissions is not technically and economically feasible and that the best available techniques are being used.

3.5 Correction at the Source Principle

The correction at the source principle reflects an option regarding the time and place for pollution abatement. Pollution can be dealt with either at the point of emission or elsewhere and at a later time, in a dedicated installation or through mitigation techniques applied at the point of impact. This is the case, for instance, of greenhouse gas emissions from industrial boilers that can be prevented "at the source" by replacing fossil fuels with renewable energy sources. Alternatively, it is possible to capture the greenhouse gases and use them in another industrial process (for instance for carbonated drinks) or inject them

[24] A political agreement approved on 10 November 2020 by the European Parliament, EU Member States in the Council and the Commission, on the next long-term EU budget and Next Generation EU (https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2354).

into geological caverns (for carbon capture and storage). Another example is reducing noise pollution from aircraft by limiting the operational period of airports to daytime hours. Alternatively, installing double glazed windows in the neighbourhoods surrounding the airport can also limit the effects aircraft noise may have on health. Several arguments can be used to support postponing pollution control measures to a later stage or transferring the responsibility for pollution abatement to third parties:

- postponing reduces pollution impacts without requiring heavy investment by the polluter;
- transferring allows specialisation in production and economies of scale, allowing some operators to specialise in dealing with pollution and polluters to outsource pollution control and abatement;
- operators specialised in treating pollution are likely to have better equipment and greater technical competence for the purpose.

However, postponing or transferring responsibility can only occur if risks and environmental impacts are not increased as a result of the geographical displacement of the polluting substances (for example, CO_2 transportation by road consumes fossil fuels and generates risks of road accidents) and provided that the overall level of environmental protection is not lowered (for example, sound insulation is not efficient for public spaces and open air activities and even in the home, during summertime when windows are left open).

As a consequence, there is a preference for measures being taken immediately at the source rather than later and elsewhere. This is the justification for the introduction of circular processes (such as reuse of cooling water for turbines) or eco-efficient technologies (such as local microgeneration of renewable energy for self-production).

3.6 Polluter Pays Principle

The Polluter Pays Principle can be found in a variety of legal sources (European Court of Auditors 2021). Many constitutions around the world have direct references to the Polluter Pays Principle (Aragão 2022). In international or supranational law, several sources define a legal regime of pollution compatible with the PPP. These sources are very useful in interpreting the principle (Schwartz 2018).

3.6.1 The PPP in EU Law

The main legal regime detailing the PPP in the European Union is the 2004 EU Directive on environmental liability with regard to the prevention and remedying of environmental damage, including damage caused by pollution (European Community 2004).[25] In the words of the directive: "the prevention and remedying of environmental damage should be implemented through the furtherance of the 'polluter-pays' principle, as indicated in the Treaty and in line with the principle of sustainable development" (preamble, §2).

Where there is an imminent threat of environmental damage occurring, the operator must take the necessary preventive measures without delay. Where environmental damage has already occurred, the operator must take all practicable steps to immediately control, contain, remove or manage the damage factors in order to limit or to prevent further environmental damage and consequent adverse effects on human health, without delay (Article 6). Naturally, the costs for the preventive and remedial actions shall be borne by the operator, directly or through insurance or other financial security (Article 14).

The regime of integrated pollution prevention and control establishes obligations on operators that clearly reflect the PPP. The operators of

[25] "According to the 'polluter-pays' principle, an operator causing environmental damage or creating an imminent threat of such damage should, in principle, bear the cost of the necessary preventive or remedial measures. In cases where a competent authority acts, itself or through a third party, in the place of an operator, that authority should ensure that the cost incurred by it is recovered from the operator. It is also appropriate that the operators should ultimately bear the cost of assessing environmental damage and, as the case may be, assessing an imminent threat of such damage occurring" (§18 of the Preamble of the Directive).

industrial installations are responsible for taking all the measures to ensure that the permit conditions are complied with. This includes taking all appropriate preventive measures against pollution, applying the best available techniques, not causing significant pollution, taking the necessary measures to prevent accidents and limit their consequences, and returning the site of operation to a satisfactory state. The operator may also be required to update the permit conditions when the laws setting environmental quality standards are updated, when the emission values established in the permit prove to be excessive or when the establishment does not seem to be safe enough.

3.6.2 Who Is the Polluter?

Where pollution is the side effect of a production process (ex. tanneries, smelters, refineries, etc.) it seems quite clear that the polluter is the operator who is responsible for the activity.

If the pollution does not begin during production but, rather, is caused by consumers while using or disposing of the product (for example, noise from motorised vehicles, use of household cleaning detergents, discarding of batteries), the consumer is the *formal* polluter. The consumer is the individual who physically causes the pollution. However, the producer who manufactures the noxious product and places it on the market is the *material* polluter.

However, in reality the situation is more complex and very often pollution is generated at different stages along the value chain, e.g. during raw material extraction, assembly, manufacture, packaging, handling, transportation, use and disposal. This is called the "pollution chain" and has been investigated in the European Community since the seventies, having first been identified by the European Council in 1975.

Instead of struggling to determine who the "real" polluter is among all the economic agents and consumers who are involved in some way, the solution to this interpretative deadlock is a pragmatic *forward-looking* procedure, rather than a *backward-looking* application. This path was adopted long ago by the European Community (European Council 1975).

Instead of a quest to find who is *more responsible* than the others for pollution, the solution is an inquiry to discover the *polluter-that-should-pay*. The challenge then, is to find the best "payer" among the different polluters (whether direct or indirect, material or moral). This interpretation is fully aligned with the ultimate goals of the polluter pays principle. In fact, the objectives of the PPP are twofold:

- first, fairness: to impose the economic burden of pollution on whoever is materially or morally responsible for polluting activities.
- second, effectiveness: to change the practices of those who have the power to change the state of affairs that leads to pollution

  The final result of this interpretation of the PPP is a fair pollution prevention policy.

3.6.3 Is the PPP Unfair?

The principle has often been accused of being unfair. Does the PPP commodify pollution? Is the PPP a licence to pollute? Is the polluter buying the right to pollute?

Questions like these do not take into account that the PPP does not replace the classic sanctioning norms of administrative and criminal law. The PPP applies beyond these norms. In the case of illegal pollution that amounts to an administrative offence or a crime (Eurojust 2021) the appropriate procedure and the sanctions applicable are inspired by classic defence rights and liability principles, not by the PPP. The PPP applies only to polluting activities that are **legal** and **accepted** for the economic and social benefits they bring, when the polluters are supposed to be encouraged to reduce their pollution to the minimum possible.

Another criticism levelled at the PPP is that it is not, in fact, the polluter that really pays but rather the victim. If polluters are allowed to pass the payments on to their clients, who really bears the economic burden at the end of the day? It is important to demystify these sceptical questions. When polluters raise the price of their products to compensate for pollution payments, thus transferring the economic loss along the value chain to consumers, they are aware that they will probably lose clients. In a competitive economy, the

demand for the polluting product or service will fall. This ultimate indirect effect of the PPP is in accordance with its *rationale* and makes cleaner products (or less polluting ones) more attractive.

In short, the PPP guides policies aimed at nudging economic activities to a greener and fairer performance.

Besides, the philosophy and strength of the PPP lay precisely in its flexibility, by leaving the polluter the option between polluting and paying or paying not to pollute.

4 The Circular Economy and Pollution Prevention

Intensive linear economic activity, which ignores the limits of the environment and the resulting long-term damage, is depleting the planet's resources. It is therefore crucial to implement strategies and solutions that enable pollution prevention and that maximise the value of resources.

Pollution prevention focuses on the elimination of waste and emissions at their source. There are two main strategies for implementing pollution prevention: one is tactical, which acts at an operational level, namely, to change the operational process to eliminate waste; the other functions at a strategic level and involves investment in a management system. This demonstrates that pollution prevention must be proactive and needs a pre-planned strategy (Kusumowardani et al. 2022).

The global priority of waste and pollution prevention encompasses improvements in production and consumption systems and associated waste management and resource recovery. Government policies need to discourage and eventually eliminate indiscriminate and environmentally harmful disposal and burning, whilst promoting the use of quality recycled materials and fostering innovation (in products, technologies, business models, lifestyle and consumption patterns) (Fadeeva and Van Berkel 2021).

With the Global Green New Deal (Barbier 2009), a new paradigm is emerging. Taking the European Union as an example, the Green Deal "is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. It also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive" (European Commission 2019). Following the European Green Deal, other pro-environment initiatives are contributing to the desired socioeconomic metamorphosis driven by the PPP. This is the case of the circular economy action plan (European Commission 2020) and the zero-pollution vision for 2050 (European Commission 2021b).

The EU's 7th Environment Action Programme to 2020 advocated 'Living well, within the limits of our planet' and called for the vision of a Circular Economy, where nothing is wasted and where natural resources are managed sustainably. In the 8th Action Programme (European Council 2021), the EU proposes "advancing towards a regenerative growth model that gives back to the planet more than it takes, decoupling economic growth from resource use and environmental degradation, and accelerating the transition to a circular economy".

In China, the Circular Economy Promotion Law, passed by the Standing Committee of the National People's Congress, in 2008, has become a point of reference for circular initiatives. A circular economy is a mode of economic development that aims to protect the environment and prevent pollution, thereby facilitating sustainable economic development (Prieto-Sandoval et al. 2018). A Circular Economy is based on the reduction, reuse, recovery, and recycling of materials and energy, transforming the linear flow into circular flows (Abad-Segura et al. 2020).

Specific Circular Economy initiatives in some member countries of the G20 (an intergovernmental forum comprising 19 countries and the EU) provide comprehensive policies to perpetuate the circulation of material and energy in these economies and promote their efficient use, while focusing on an increase in

renewable inputs. They target several stages of the life-cycle—from design to return to the production-consumption cycles, and comprise a variety of laws, regulations and programmes (Fadeeva and Van Berkel 2021). For example, incineration and landfill taxation can effectively diminish the environmental impacts of pollution and resource use by reducing their pollutants while stimulating the reuse and recycling of materials, hence encouraging a circular economy. Appropriate design of these policies is key for circular economy strategies to obtain effective environmental results while minimising economic impacts (Freire-González et al. 2022).

In a "zero pollution" and circular economy scenario, polluters must find innovative ways to monetise externalities. Where certain undesired side effects of their activity cannot be avoided (whether these relate to solid substances, liquid discharges, gas emissions, heat, light, or radiation), they will need to be used in other production or consumption processes. To quote the European Commission in its zero-pollution communication, "we no longer need to accept pollution that affects people and the environment as an inevitable side product of progress". The circular economy is thought to have the capacity to "deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities" (European Commission 2021b).

Some important examples have demonstrated the key role of the circular economy in preventing pollution. One of most relevant examples are plastics. Although plastic is one of the materials that we most use in our daily lives, the current linear economy ('produce, use and dispose') engenders high risks to human health in terms of greenhouse gas (GHG) emissions and environmental pollution.

To reduce the amount of waste and pollution from plastics, it is crucial to study not only how to recycle plastic, but also how to create a circular value chain. One challenge that has been identified is to produce rules and legislation focused on regulating the end-of-life phase (e.g., waste management legislation), which means that other important factors are not addressed (Johansen et al. 2022). Clearly, global action—and coordinated action—is required for there to be a lasting societal and environmental change. Plastic pollution prevention can thus begin with policies for wider and more focused application of known good practices, through consistent policy and implementation, in collaboration with consumers, producers, farmers and other waste generators and formal and informal waste management sectors (covering collection, recycling, recovery and environmentally sound disposal). Responsible behaviour by all partners is necessary, along with business-like methods and systems (Fadeeva and Van Berkel 2021).

Implementation of circularity principles in agriculture is imperative for pollution control and will facilitate the transition towards planet healthy farming practices so that food production paths can be transformed in a manageable, replenishable, and sustainable way, in line with the aspirations of the UN-SDGs practices. This will promote resource conservation while regaining soil fertility and moisture content through improved soil carbon sequestration. Regenerative agricultural practices based on resource conservation and replenishment are therefore imperative to reduce negative environmental impacts (Dubey et al. 2021).

Management of industrial fruit by-products is important not only to decrease the volume of food waste accumulated in landfills, but also to develop strategies through re-use with the purpose of valorising and adding economic value. The disposal of food waste leads to different global impacts in different sectors, such as social, environmental and economical. Integration of the valorisation concept allows fruit waste to be converted into high-value products with relevant potential applications for human consumption, such as extraction of specific molecules and the production of antioxidant extracts and functional flours. Such transformation requires food, nutraceutical and pharmaceutical industries to open their doors to improving the biological activities of current products, as well as the development of novel products (Campos et al. 2020).

5 Rationale of Pollution Law

The final reason that explains and justifies efforts to regulate, tax, charge for, clean up, supervise and sanction pollution is protection of the victims of pollution. Pollution is harmful to people, animals, plants, microorganisms, ecosystems, rivers, lakes, mountains, forests, the atmosphere, the stratosphere, the planet and other planets. According to the Lancet Commission on Pollution and Health (2017), pollution is now the largest environmental cause of death in the world—1 in 6 people die from pollution-related causes (Landrigan et al. 2018). The new concept of Planetary Health was discussed in Helsinki in December 2019 (Finnish Institute for Health and Welfare -THL 2019), by researchers, policymakers, and regulators, and highlighted the urgent need to act as scientific evidence shows that human activities are causing climate change, biodiversity loss, land degradation, overuse of natural resources and pollution (Halonen et al. 2021).

Current and future generations deserve a pollution-free world. However, what is surprising is that human communities are not uniformly exposed to pollution (WHO 2019; Aragão 2021). The effects of pollution on health have recently been placed under the spotlight as several studies have revealed that minorities and the most vulnerable persons are more exposed to environmental pollution and unhealthy environments than the average population (EEA 2018). What is worse, the prevalence of vulnerable social groups living in deteriorated environments is growing (Eurostat 2019).

Territorial injustice, also called spatial justice, is the result of several of these inequities occurring in the same region, community or place. Furthermore, territorial injustice caused by pollution can also occur between countries, and hence territorial injustice is a crosscutting problem with international incidence.

In fact, most pollutant emissions—air pollution, water pollution, soil pollution, noise, radiation—are more severe near their source, and gradually fade as they move away from it. Consequently, those living in the vicinity of sources of pollution and hazards are the most vulnerable populations (UN HRC 2018).

More shockingly, the most vulnerable individuals or groups are also those who are less resilient and unable to take self-protection measures. Abandoning a contaminated area and moving to live elsewhere is only possible when the environmental victims have the economic capacity to leave their home (selling it for a low price or simply leaving it) and try to resettle somewhere else. Consequently, the more economically disadvantaged victims are forced to stay and endure the slow violence (Nixon 2011) of living in a polluted and unhealthy environment.

This is why the preventive approach is so important. The social effects of pollution are unfair and must, therefore, be averted.

6 Conclusion and Future Perspectives

The legal regime of pollution, shaped by the fundamental environmental principles, seeks to achieve higher levels of environmental protection, as required by the European Treaties (for instance, Article 3(3) of the Treaty on the European Union states that "the Union shall work for sustainable development of Europe based on balanced economic growth and price stability (. . .) and a high level of protection and improvement of the quality of the environment").

Pollution is a battle that can be won. In the latest results of the Global Burden of Disease, for example, the age-standardised death rates for all causes of air pollution were reported to have fallen by 23% between 2006 and 2016 (Das and Horton 2018). There is still a long way to go, so it crucial to accelerate our joint efforts and response. All governments and decision makers need to address the health impacts of pollution and major environmental threats on a regular basis to prompt timely and definitive actions. A shift from fragmented approaches to policy and practice towards systematic actions will promote human and Planetary Health. Global, regional,

national, local, and individual initiatives are called for and multidisciplinary and multi-sectorial actions and measures are needed to stop the consequences of pollution. Systems thinking will feed into conserving nature and biodiversity, and into halting climate change (Halonen et al. 2021).

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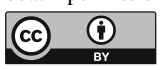

Suing States: The Role of Courts in Promoting States' Responsibility for Climate Change

Armando Rocha

Abstract

In the era of climate change, decisive action is needed from States. However, it is dismaying to see the lack of ambitious efforts in climate treaty negotiations, which is reflected downstream in the ambiguous nature of non-binding or soft mitigation obligations. In that light, this article argues that courts can be agents of change and pressure States, *cum grano salis*, to take decisive action. Domestic courts may be better positioned to compel States to adopt stringent mitigation measures, but all courts (international or domestic, general or specialised) may *press for regulation* or *assess regulation*. In both cases, courts are helpful in mapping States' obligations under international law (including, but not exclusively, the UNFCCC legal framework).

Keywords

Climate change · Courts · International responsibility · Mitigation obligations

1 The Devil Is in the Detail—States' Climate Inaction

Climate change is the main challenge we face as a species. As a challenge, it could be considered as formidable and daunting as preventing an asteroid from colliding with our planet—but unlike asteroids, climate change is triggered by *human* activities. Since mankind has rewritten the rules of the game, we now live in the so-called 'eighth day of creation' (Beck 2002): the day humankind gained possession of the technical and technological means to master nature. As a result, nature is no longer 'natural,' but rather a man-made meta-reality (Beck 2002, p. 37); in the age of the Anthropocene, "[m]an is the maker of his life *qua* human, bending circumstances to his will and needs" (Jonas 1984).

In very simple terms, climate change is the result of excessive greenhouse gas (GHG) emissions, which contribute to global warming and ultimately to climate change. More particularly, climate change is caused upstream by the aggregate concentration of GHG poured into the atmosphere by *all* States, and not just one State alone. Therefore, the atmosphere is the best example of a global commons affected by negative externalities. Since GHG emissions are *transboundary* by nature, global warming is indeed *global*, and the climate system is *shared* at the planetary level, we are all affected by climate change phenomena. Having said that, the emitter and/or beneficiary of GHG emissions is

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not necessarily the party *most* affected by such emissions and climate disruption. Yet, climate change is not *just* an example of a negative externality: "global warming [and the resulting climate change] is the Goliath of all externalities" (Nordhaus 2013); it affects the entire planet and every single aspect of our lives.

This has deep implications in terms of the behaviour to be expected from States. For instance, it explains why *all* States must act decisively in order to curb GHG emissions and, in so doing, avoid crossing a dangerous threshold of climate disruption, but also why one State *alone* is a simple and helpless bystander. Therefore, climate change is the ultimate example of a problem requiring global cooperation between all States. To that end, States have adopted the 1992 UN Framework Convention on Climate Change,[1] the 1997 Kyoto Protocol, the 2015 Paris Agreement, and other instruments of ambiguous nature under this umbrella.[2] But the devil is often in the detail, or, one might say, in the costs. Mitigation efforts are costly and adaptation costs may be even higher or difficult to quantify (e.g. what price should be put on the loss of a species?), and, in the short-term, States tend to focus on the negative impact of mitigation policies on their citizens. More importantly, mitigation efforts may be costly for a particular State, but they benefit the entire planet. Thus, free riding is possible and seems to be encouraged: if States can benefit from mitigation efforts undertaken by others, why would they impose costs upon their own citizens? Why would they adopt such mitigation efforts if others are not pursuing the same efforts also? This helps to explain why States adopt unambitious mitigation efforts or underperform in relation to mitigation targets, or even why States prefer not to commit too much at the international level (Bodansky 2015).

In this context, my argument is that courts can be pivotal in ensuring that the goals and efforts contained in climate treaties are *ambitious* and *accomplished*. To that end, this article examines the role of courts in the legal system and assesses the possible avenues courts can take to *promote* State's responsibility *for* climate change (within the UNFCCC legal framework or otherwise). Accordingly, this article focuses on both domestic and international courts, while bearing in mind that often their different position explains a different role.

2 Empowering Courts—Or Empowered by Courts

Climate litigation (before international or domestic bodies) has been on the rise in recent years. Curiously, the UNFCCC established a particular system for settlement of disputes[3]—but that system has generally kept climate litigation at bay. Cases brought before the courts are diverse, but the purpose of climate litigation seems to be simple: to enhance States' mitigation and adaptation efforts. In the light of the dismaying outcomes of the successive negotiations and States' systemic under-performance in achieving climate goals, some players (e.g. private entities and small island States) have pondered resorting to the courts to put pressure on States, requiring them to regulate their GHG emissions or check the adequacy of their regulatory framework to cope with climate change.

Using courts to enhance climate policies seems to be at odds with the traditional function assigned to courts. Traditional views state that each branch of the State has its own role in dealing with climate change effects, but courts should be detached from politics, and therefore their function should not be to enhance a particular cause or movement. Nonetheless, courts exercise both a private and a public function: the former involves settling disputes between parties, while the latter involves clarification of the legal rules and principles applicable to virtually all future disputes (Lowe 2012), such as States' liability for GHG emissions, or the compensation owed to those affected by climate change events.

[1] Hereinafter referred to as the 'UNFCCC'.

[2] Hereinafter referred to as a whole as 'the UNFCCC legal framework'.

[3] Articles 14 of the UNFCCC, 19 of the Kyoto Protocol, and 24 of the Paris Agreement.

Exercising this public function erodes the boundaries between interpreting and creating the law[4]—but irrespective of one's position regarding the role of courts, they do play a major role in the downstream making of (international) law (Boyle and Chinkin 2007). This is not a minor conclusion: when courts settle disputes or issue an opinion, selecting, interpreting and applying the law is an opportunity for them to make a 'meaningful contribution' to tackling climate change issues (Preston 2016). They may not be able to decide which mitigation efforts are to be pursued by the political community, but they can establish facts and clarify whether the mitigation efforts so far undertaken are adequate to meet States' obligations or to accomplish the goals of the UNFCCC legal framework. As such, they can hold the executive branch accountable for its conduct and ask it to comply with the laws on climate change—the same way they ensure that private actors comply with the dictates of climate change law applicable to them (Preston 2016, p. 13). In other words, when settling climate change cases, courts are *empowered* and can contribute decisively to establishing States' (*ex ante* and *ex post*) responsibility.

Furthermore, enhancing mitigation efforts means more than enlightening the players of the legal system on the applicable rules and principles. From a sociological perspective, courts can also exercise an *empowerment* function, and thus enhance climate action, since courts are a public forum where States, individuals or other entities affected by climate change can bring and discuss their justiciable rights. Third-party enforcement mechanisms have a *protest* role (Lobel 2004), meaning that they can be used to promote societal changes and function as "arenas where political and social movements agitate for, and communicate, their legal and political agenda" (Lobel 2004, p. 479). Therefore, "winning in court is not as essential" for this purpose (Lobel 2004, p. 480), because the simple submission of a case can be a catalyst for disseminating a particular message or exerting pressure over a specific entity (Lobel 2004, p. 487; Lin 2012). Submitting a claim with only this purpose in mind might be objectionable, and perhaps even an abuse of the right to bring a claim, as it goes against the very heart of what is commonly understood as the role and function of courts in a legal community. However, from a sociological standpoint, courts also have this function (Rocha 2021). In that role, courts do not replace States, but they act as "purveyors of legitimacy", namely when they "raise consciousness on a particular matter", and "help us understand what needs to be done, or what is being done inadequately or not at all" (Sands 2016, p. 24). This was particularly visible in the *Urgenda* case; more than the legal intricacies of the decisions adopted by the Dutch courts, the most important outcome was the buzz in public opinion and the boost to global and transnational climate litigation. Providing legitimacy in this case was possible because courts share an institutional authority and their decisions are taken seriously. This is important for climate litigation, where the symbolic meaning of a court's decision is key. Even if a case is won, winning is not enough, since courts cannot replace or compensate the loss of biodiversity and cannot ask nature to stop warming the planet. But because symbols matter, courts' decisions can raise awareness and trigger public policies. In the end, if the court's decision is purely symbolic (i.e. it unveils States' mitigation obligations under the UNFCCC legal framework, but does not condemn States to any specific action), it creates a precedent which, because it does not require any tangible compliance and thus States cannot logically fail compliance, increases the court's reputation and that of the idea conveyed in that decision (Dothan 2015)—i.e. it contributes to its institutional empowerment as an agent enhancing climate action. This function is relevant for two reasons: first, unlike political bodies, courts cannot decline to decide on the merits of an admissible case based on the absence, inconsistency, or lack of clarity of the law, or based on the political sensitivity of a case (prohibition of *non-liquet*) (Preston 2016, p. 12); second, since politicians

[4] As Dworkin (1998, p. 229) said, 'the distinction between author and interpreter [is] more a matter of different aspects of the same [mental] process.'

are afraid of the recalcitrant electorate and want to shield behind another institution, courts' decisions can be a useful means of outsourcing guilt and justifying compliance with that decision in order to adopt more ambitious mitigation efforts.

Considering States' responsibility for climate change, how can *empowered* courts *empower* further action on climate change? Adopting Jolene Lin's classification (Lin 2012, p. 36), in my view, courts can be agents of change in two ways: first, courts can *press for regulation*, namely in cases where this is lacking or incomplete (e.g. if a State has ratified but not conferred direct effect to a treaty within its domestic legal order); second, courts can *assess regulation*, namely by identifying cases of poor regulation (i.e. the existing mitigation obligations are inadequate to comply with the goals of the UNFCCC legal framework), or by clarifying or unveiling States' obligations under international law, which may include filling regulatory gaps (e.g. deciding on issues regarding judicial standing, the liability of States for excessive GHG emissions, or their duties of care under human rights treaties). In both cases, courts can be decisive in mapping States' obligations under international law.

3 Mapping States' Obligations Under International Law—Yes, the Devil IS in the Detail

Since climate litigation can help map States' obligations under international law, courts can be agents of regulatory change. The scope of these obligations is a politically divisive topic in climate negotiations. Apart from the costs that mitigation efforts carry, it does not help that this topic is often intertwined with climate justice topics (such as developed States' reparation for historical GHG emissions, or their obligation to lead the mitigation efforts under the principle of common but differentiated responsibilities),[5] and often discussions mix States' *ex ante* and *ex post* responsibility. Moreover, lawyers and State representatives in the negotiations share an unwelcome bias: they (we) often "think about violation only if there is a norm. But, with global risks, a new global horizon is emerging from the experience of the past and expectation of future catastrophes. The sequence is turned upside down—the violation comes *before* the norm" (Beck 2016). In other words, in the age of climate change we ought to conceive the violation itself as being a norm-generator: it ought not to be the consequence of a violation *only*, but the source of the norm *also*. Regardless of what was or is the state of knowledge we had or have, the simple fact that climate change effects are daunting should be the source of an obligation to mitigate and adapt *and* the violation and resulting responsibility for that norm's violation. But that would require a deep change in the way we conceive the operation of law.

In any case, the grim reality is that States have not been very eager to establish hard obligations to mitigate climate change. As the IPCC pointed out, "[b]ecause greater legal bindingness implies greater costs of violation, states may prefer more legally binding agreements to embody less ambitious commitments, and may be willing to accept more ambitious commitments when they are less legally binding" (Stavins et al. 2014). As a result, treaties such as the Paris Agreement (the most sophisticated climate change treaty so far devised) include a few binding obligations, but mostly contain soft or non-binding obligations (Rajamani 2016). Ultimately, the main achievement of the Paris Agreement was the inclusion of "provisions that either have weak normative content or seem to be wholly lacking in it. These provisions do not create rights and obligations for States, (...) rather they provide context, offer reassurances and construct narratives" (Rajamani 2016, p. 337). The same can be said with respect to the UNFCCC or the Kyoto Protocol, where one can observe "the crushingly vague nature of the obligations, invariably drafted in such a way as to make it impossible to argue that any particular provision gives rise to a cause of action" (Sands 2016). In this context, how can courts be helpful at all?

[5] Article 4(4) of the Paris Agreement.

A first role courts can play is to *press for regulation*. This can happen in cases where regulation is lacking or is incomplete, namely if a State has not ratified the UNFCCC, the Kyoto Protocol, or the Paris Agreement, of if it has not conferred direct effect within its domestic legal order.[6] One can imagine an international court claiming that States are not complying with treaty provisions despite the lack of direct effect within the domestic legal order, but it cannot force a State to ratify a climate treaty. For their part, domestic courts can be helpful and pressure their own State. For instance, they may apply the treaty irrespective of any domestic provision conferring direct effect (Rocha 2021, pp. 71–75); and they can resort to domestic law provisions to enhance climate action. However, it is unlikely that domestic courts will use this avenue, since filling a regulatory gap erodes the boundary not only between the judicial and legislative branches but also between law and science, which leads to courts being placed outside the traditional judicial role. As a result, one can expect courts to be very cautious and take refuge in the lack of constitutional competence to press for regulation, unless they are able to resort to domestic means such as that of unconstitutionality by omission.

A second role courts can play is to *assess regulation*. In this case, the problem is not regulation that is lacking or incomplete (in the sense mentioned before), but rather poor regulation. This may arise from the insufficiency and/or unsuitability of the climate measures adopted at the domestic level, but also from the vague wording of the treaty provisions adopted by States. Initially, domestic courts were reluctant to exert such pressure or to fill regulatory gaps, and voiced concerns over the separation of powers. Recent cases, however, show that domestic courts are now more comfortable with stepping in and asking States to take adequate measures (Banda and Fulton 2017, p. 10122). The leading and landmark *Urgenda* case is a prime example of this audacious approach, although it is primarily based on the constitutional duty of care that binds States. [7] More recently, the same approach was followed by the German Constitutional Court in its landmark decision of 24 March 2021,[8] which connected the duties under the German Constitution with the State's obligations under the UNFCCC legal framework.

In fact, courts cannot create the law, but they can provide enlightenment on the applicable law and pinpoint gaps in States' compliance. Their task, therefore, is to assess whether there is any mitigation obligation (i.e. an obligation to reduce GHG emissions or to increase sinks and reservoirs), and what the results of this are. Given the many doubts that exist regarding this topic, courts can be decisive in unveiling States' mitigation obligations under the UNFCCC legal framework. In fact, resorting to the general principles of law, it is not difficult to say that, under the no harm principle, States have an obligation to prevent a dangerous level of climate change, or that they have an obligation to avoid excessive anthropogenic emissions of GHG within their jurisdiction (Sands 2016, p. 31; Mayer 2018, p. 109). The climate treaties also include references to a possible mitigation obligation, but their wording is slim. The first reference to such an obligation can be found in Article 2 of the UNFCCC, according to which "[t]he ultimate objective of this Convention (. . .) is to achieve stabilization of [GHG] concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". Thus, a collective goal was defined, but the UNFCCC failed to establish binding quantitative targets and timelines. Article 4 of the UNFCCC adds some mitigation-related obligations, mostly of a procedural nature, including a binding obligation on developed States that requires each of them to "adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of [GHG] and enhancing its

[6] For example, on the grounds of lack of publication in the official journal.

[7] *Urgenda Foundation v. The Netherlands*, The Hague District Court (24 June 2015) §§ 4.52 and 4.53.

[8] Cases no. BvR 2656/18, 1 BvR 78/20, m1 BvR 96/20 and 1 BvR 288/20.

[GHG] sinks and reservoirs",[9] with a view to "returning individually or jointly to their 1990 levels".[10] As such, the UNFCCC is certainly an interesting basis for interpreting State's obligations, but it is not the source of any binding obligation. At most, it created a "non-binding quasi-target and -timetable" (Bodansky et al. 2017). But at least it triggered a discussion regarding mitigation, and, specifically, whether such efforts should be quantified in a binding treaty provision, which (positive or negative) emissions should be eligible, which States should pursue such mitigation efforts (and who should lead those efforts), and whether States can rely on mitigation projects developed in another State's territory (Bodansky et al. 2017, p. 132).

The first step towards quantification was taken in 1997, through the Kyoto Protocol, Article 3(1) of which establishes that "[t]he Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic [GHGs] (...) do not exceed *their assigned* amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B (...), with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012". As such, the Kyoto Protocol set out, for the first time, a binding, treaty-based obligation to reduce GHG emissions. At the end of the first commitment period (2008–2012), it was possible to see that the goals were being achieved and, as a result, the Doha Amendment established a second commitment period (2013–2020), in which States agreed to "individually or jointly" reduce their GHG emissions "by at least 18 per cent below 1990 levels".[11]

For its part, the Paris Agreement set out, in Article 2(1), that it "aims to strengthen the global response to the threat of climate change (...) including by: (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels". The drafters refrained from using rights-based or duty-based wording, and instead opted for a goals-oriented approach. They did, however, include a reference to an individual and binding mitigation obligation: pursuant to Article 4(2), "[e]ach Party shall prepare, communicate and maintain successive nationally determined contributions[12] that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objective of such contributions". States are required to communicate new NDCs every five years,[13] taking into account that each successive NDC 'will represent a progression over time.'[14] The magic formula, thus, was to allow States to determine their own mitigation obligations. This solution certainly encourages treaty ratification—but it does not prevent the submission of unambitious NDCs (Mayer 2018, p. 48), despite the explicit reference to "ambitious efforts" in Article 3. At most, one can say that at least nominally each NDC must appear to be more ambitious than the previous one, and where there is a systemic and persistent lack of reasonable ambition in the NDCs submitted, a State is not complying with its obligations under the Paris Agreement (Mayer 2018, p. 114). Moreover, the wording of Article 4 is peculiar and includes elements of soft and hard obligations (Rajamani 2016, p. 453). In fact, a treaty obligation is not necessarily a binding obligation; it depends on the wording (e.g. 'shall' v. 'should'), the detail of the obligation elements, or even the enforcement mechanisms available (Werksman 2010). In the Paris Agreement, the mix of soft and hard obligation elements is puzzling at best.

This framework is not particularly heartening. There is an international obligation to reduce GHG emissions, but its content is slim and bleak. So, what can courts do to map States' obligations? Before an answer can be provided to this question, one point must be made

[9] Article 4 (2) (a).

[10] Article 4 (2) (b).

[11] Article 3 (1*bis*) of the Kyoto Protocol, added by Article 1, § C, of the Doha Amendment.

[12] Hereinafter referred to as 'NDCs'.

[13] Article 4 (9) of the Paris Agreement.

[14] Articles 3 and 4(3) of the Paris Agreement.

regarding the dispute settlement mechanisms available for climate change litigation.

Treaty enforcement is always radically problematic, regardless of the treaty. Having in mind Article 36(2) of the Statute of the International Court of Justice,[15] Article 14 of the UNFCCC devised a form of advance consent to the compulsory jurisdiction of the ICJ and/or an arbitration tribunal. This solution was transposed into the Kyoto Protocol[16] and the Paris Agreement.[17] In theory, this solution is welcome, but so far, only the Netherlands has accepted the jurisdiction of both the ICJ and an arbitration tribunal, whereas Tuvalu and the Solomon Islands have recognised the jurisdiction of an arbitration tribunal. Therefore, only with a leap of faith can one imagine, in the near future, State-to-State litigation under the UNFCCC legal framework (Henin 2019). At most, since States can issue a similar declaration under Article 36(2) of the ICJ Statute itself, this provision may be used to bring a case before the ICJ. If a dispute is ever brought before the ICJ or an arbitration tribunal, one would expect, initially, some cautious behaviour from the court, followed by a more activist and creationist attitude later on. The benefits of that activist behaviour might be clarification as to, for example, a State's precise mitigation obligations under climate treaties (i.e. what its individual efforts in terms of reducing GHG emissions are); how the *ex ante* responsibility relates to other States' (and all States') symmetric obligations; whether an infringement is attributable to one State or to more (or all) States; the role played by the shared responsibility principle as expressed in Article 47 of the Draft Articles on Responsibility of States for Internationally Wrongful Acts?;[18] the legal consequence in case of infringement (e.g. should States cease the conduct and not repeat it, as mentioned in Article 30 of the ARSIWA? Should States compensate for the injury caused, as mentioned in Article 31 of the ARSIWA? If so, to whom should compensation be paid?); the exact scope of the no harm principle and the principle of common but differentiated responsibilities, and the respective capabilities principle; or how the *Monetary Gold* principle should be applied in the context of climate litigation.

An alternative option, then, may be to resort to the ICJ's advisory jurisdiction, as has been advocated by Pacific island States.[19] Pursuant to Article 96 of the UN Charter, the UN General Assembly, the Security Council, or any other organ or agency of the UN (provided it is so authorised by the General Assembly) may request an advisory opinion from the ICJ.[20] The purpose of an advisory opinion is not to adjudicate between parties but to enlighten the players of the international community on a particular reading of an international legal rule or principle. As such, advisory opinions do not have binding effect on a specific jural relationship, but they still carry the institutional *auctoritas* to clarify the law existing and binding upon States. Therefore, an advisory opinion cannot decide if a particular State is liable for past GHG emissions or establish a causation link between such GHG emissions and a particular loss, but it can explain *urbi et orbi* under what conditions such liability may arise or what causation criteria could be used. If the goal of an advisory opinion is to clarify the law, it may be preferable in a contentious case, where the analytical intricacies of the dispute may disturb future readings (Oellers-Frahm 2011). Moreover, advisory opinions may also have the advantage of allowing more States to bring in their views on an equal footing, and to allow the ICJ to draft its reasons in more general terms, thus avoiding issues such as the establishment of causation links. However, this alternative avenue is not risk free; requests for advisory opinions need to be *politically* approved by the UN General Assembly, and the more generic nature of advisory opinions may lead the ICJ to take a more conservative and cautious approach when determining States' *ex ante* or *ex post* responsibilities

[15] Hereinafter referred to as the 'ICJ'.

[16] Article 19 of the Kyoto Protocol.

[17] Article 24 of the Paris Agreement.

[18] Hereinafter referred to as 'ARSIWA'.

[19] 50th Pacific Islands Forum (13 to 16 August 2019). Forum Communiqué, § 16.

[20] Article 96 of the UN Charter.

with regards to GHG emissions (Sands 2016, p. 20; Mayer 2018, p. 241). This means that it all comes down to the sensitivity of the question asked; while a question on the no harm principle would be unlikely to raise any alarm at The Hague, a question put to the ICJ on historical reparation would almost certainly not be so welcome (Mayer 2018, p. 242).

If it is not realistic to expect the ICJ to decide on a climate change-related case, domestic courts may be used to enhance States' obligations under the UNFCCC. In fact, domestic courts are the first port of call for the enforcement of any international obligation. This article focuses on international bodies, but in the light of the difficult access to international courts and the insufficiently characterised nature of most obligations under the UNFCCC legal framework, domestic courts play a pivotal role in climate litigation (Mayer 2018, p. 238). They cannot adjudicate *urbi et orbi*, but they can establish a 'precedent' (relevant for the international community but also in terms of setting out a transnational pattern of judicial regulatory behaviour) with regards to what mitigation efforts are binding on their own State and how these should be calculated, what criteria can be used to assess attribution of conduct to States or to determine causation links, when responsibility or liability for loss and damage arises, or what adaptation measures are required. Furthermore, whereas international courts can only consider States' international obligations, domestic courts can also connect international and domestic obligations in a meaningful way, in the same way that they can assess, in the light of their domestic law, whether the NDC submitted by the particular State is adequate to comply with that State's international obligations. This shows that the relationship between international and domestic law (as between international and domestic courts) is not one of two nations who do not know each other, but rather one that entails cooperative moments.

Finally, some words must be dedicated to considering the possible role of *other* international courts. In fact, the widespread effects of climate change challenge the very fabric of international law *and* its special regimes. One field which has been specifically affected is human rights law. One only needs to consider the impact global warming can have on human health, access to water or food, or our quality of life, to see how climate change may jeopardise the enjoyment of human rights (See, *inter alia*, Humphreys 2012; Bodansky et al. 2017, pp. 295–313; Boyle 2018; Wewerinke-Singh 2021). In that light, in 2005, the Inter-American Commission on Human Rights received the *Inuit Petition Seeking Relief from Violations Resulting from Global Warming Caused by Acts and Omissions of the United States*. This was a pioneer claim which primarily sought not to compensate the claimants for any climate-related harm, but rather to raise global awareness regarding the effects of climate change (Lin 2012, pp. 53–54). In 2009, another petition was submitted, this time before the World Heritage Committee, regarding *The Role of Black Carbon in Endangering World Heritage Sites Threatened by Glacial Melt and Sea Level Rise*. In 2015, a citizen of Kiribati brought a case to the UN Human Rights Council; [21] and, just to finish this short list of examples, in 2020, a group of Portuguese children lodged an application before the European Court of Human Rights. [22] In all cases, the applicants brought a climate change-related issue before a human rights body. In fact, the applicants selected a (different) segment of the same climate change-related facts and asked the human rights body if the State was complying with the relevant human rights treaties—not if it was complying with the UNFCCC legal framework. Jolene Lin qualifies these as 'marginalised concerns' (Lin 2012, p. 40), in the sense that they are not conveyed in the UNFCCC legal framework, but that does not mean that climate change concerns are not shared by other fields of international law, and, in particular, it does not prevent cross-regime interaction, as mandated by Article 31(3)(a) of the 1969 Vienna Convention on the Law of Treaties. Quite the contrary, since

[21] *Ionae Teitiota v. New Zealand*, Communication No. 2728/2016.

[22] *Duarte Agostinho and Others v. Portugal and 32 Other States,* App. No. 39371/20.

systemic interpretation is mandatory and international law is a unified legal system, a human rights body may decide on the effects of climate change on the enjoyment of human rights. What are the merits of such an avenue? Two, at least.

Firstly, resorting to specialised international courts and bodies may be relevant if private access is granted (as is the case of human rights bodies). In fact, the procedural strategy of States might make them refrain from litigating, for fear of damaging their diplomatic relations or retaliation in future proceedings; or they might just consider a specific legal point to be tangential within the general line of arguments (Stephan 2011). Why would a State complain against another State's NDC, when it may also be under-complying with its obligations, or if it may create a precedent that could backfire in the future? However, evidence suggests that non-State actors are more likely to withstand economic interests, and less likely to be captured by these interests (Stephan 2011, p. 1617), and they do not face the same constraints as States, since they do not stand behind prior claims before international bodies, and do not have to fear future proceedings against them (Stephan 2011, p. 1642). Moreover, whereas human rights bodies are relatively open to receive any case that relates to their constituent treaty, the ICJ has expressed the need to be politically cautious, namely in stating that it can decline 'to adjudicate on the merits of an application' if such adjudication 'would be inconsistent with its judicial function'.[23] Secondly, whereas the UNFCCC legal framework is wanting in terms of characterising States' obligations with respect to mitigation or adaptation measures, the duty of care and the doctrine of positive obligations may be used as a tool to pinpoint such mitigation and adaptation obligations towards individuals. As such, enlarging State's climate change-related obligations may be a surprising effect of the access of private actors to the international arena.

Finally, the effects of climate change on the marine environment justify possible use of the law of the sea to also complement the UNFCCC legal framework. Hence, the United Nations Convention on the Law of the Sea[24] may also be used to identify climate change-related States' obligations (e.g. the duty to protect and preserve the marine environment) (Boyle 2012), or to identify possible avenues for addressing climate change effects (e.g. the impact of sea-level rise, or deep-sea carbon storage). Accordingly, another option is the use of the advisory competence of the International Tribunal for the Law of the Sea,[25] in order to obtain an authoritative position on ocean affairs and climate change. This option was considered by disappearing island States, to whom climate-driven sea level rise is an existential threat. Thus, on 31 October 2021, Antigua and Barbuda and Tuvalu signed a Treaty on the Commission of Small Island Developing States on Climate Change and International Law, with a view to requesting an advisory opinion from the ITLOS (United Nations Climate Change 2021), namely on climate change, sea-level rise, the protection and preservation of the marine environment, and States' international responsibilities. The advisory opinion has not yet been requested, but clearly this prospect is not simply a figment of the imagination. If cherry-picking is a normal operation of international dispute settlement, the ITLOS option has the advantage of circumventing the difficult majorities in the UN General Assembly.

4 Final Remarks

Traditional views consider courts as passive players, in the sense that they cannot look for cases, but wait for cases to be submitted to them. However, the fact is that once their jurisdiction is triggered, courts do play a role in boosting a specific action, including climate action. Although on different terms, this empowerment role can be played by domestic and international courts, whether specialised or not. In that

[23] *Northern Cameroons (Cameroon v. UK)* (Preliminary Objections) [1963] ICJ Rep 15, 37.

[24] Hereinafter referred to as the 'LOSC'.

[25] Hereinafter referred to as the 'ITLOS'.

capacity, courts can press for regulation, namely if the State lacks climate regulation or has not completed the regulatory process, and they can also assess climate regulation in order to check if it is adequate to cope with climate change. In both cases, by mapping States' international obligations, courts can be agents of change and boost climate action.

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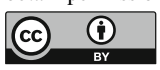

Marine Biodiversity Beyond National Jurisdiction

Irini Papanicolopulu

Abstract

Areas beyond national jurisdiction (ABNJ), which include both the high seas and the seabed area beyond the external limit of the continental shelf, cover more than half of our planet's surface. They contain a wealth of living resources and play a crucial role in many earth processes, making their protection necessary for the current and future generations. However, the current regulatory framework has proven insufficient to address the many threats that endanger ABNJ. This chapter will present the current legal framework purporting to protect marine biodiversity in ABNJ and will assess its actual reach. It will then briefly discuss the current, ongoing negotiations at the United Nations, aimed at the adoption of a legally binding instrument to protect ABNJ, and will conclude with some thoughts on the role and limits of ABNJ protection through international law instruments.

Keywords

High seas · Area · Marine genetic resources · Areas beyond national jurisdiction

1 Introduction

Oceans, seas and coastal areas form an integrated and essential component of the Earth's ecosystem and are critical to sustaining it.[1] In particular, the ocean and its ecosystems provide significant benefits to the global community, which include climate regulation, coastal protection, food, employment, recreation and cultural well-being (United Nations 2021, p. 5). Oceans and their biodiversity, however, are currently under severe threat. Climate change is affecting the oceans in different ways (Laffoley and Baxter 2016; Hobday and Matear 2020); depletion of marine living resources is ongoing;[2] pollution of the marine environment, including plastic pollution[3] and noise pollution (McKenna and International Fund for Animal Welfare 2008), is increasing.

[1] "The Future We Want" UNGA Res. 66/288 of 27 July 2012, para. 158.

[2] According to FAO (2020, p. 47), "the fraction of fish stocks that are within biologically sustainable levels decreased from 90 percent in 1974 to 65.8 percent in 2017 [. . .]. In contrast, the percentage of stocks fished at biologically unsustainable levels increased, especially in the late 1970s and 1980s, from 10 percent in 1974 to 34.2 percent in 2017."

[3] Plastic pollution has been addressed in four United Nations Environment Assembly resolutions of 2014, 2016, 2017, and 2019, collected in UN Doc UNEP/AHEG/2019/3/INF/2 of 25 October 2019. For background information see the report *Breaking the Plastic Wave*, available at breakingtheplasticwave_report.pdf (oneplanetnetwork.org).

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Within oceans, marine biodiversity is impressive: the seas are home to up to 80 per cent of all life on planet earth. Yet, marine biodiversity is rapidly decreasing[4] due to human activities, including fishing, aquaculture, shipping, sand and mineral extraction, oil and gas exploitation, the building of renewable energy infrastructures, coastal infrastructure development and pollution, including the release of greenhouse gases (United Nations 2021, p. 10).

The importance of the oceans make it essential to engage in strict normative action in light of the threats currently faced, with the aim of mitigating existing phenomena and addressing major threats and their harmful consequences. In order for such normative action to be successful, it must be undertaken at the international level. From a practical point of view, the ocean is unique and all seas and basins are interconnected, and hence fragmented action will not suffice to address threats and dangers which are often transboundary and sometimes global. From a normative point of view, the high seas and the seabed beyond national jurisdiction, together known as areas beyond national jurisdiction (ABNJ) form the largest part of marine waters. ABNJ do not fall within the jurisdiction of any single State; consequently, any measures need to be multilateral. For this reason, States have created a number of international bodies tasked with managing activities in ABNJ, including protection of the marine environment and preservation of marine living resources (Freestone 2014). Yet protection of marine biodiversity in ABNJ has long remained only loosely regulated.

This chapter will present the normative framework developed by States to protect biodiversity in ABNJ (Warner 2015; Nordquist et al. 2019; Nordquist and Long 2021). In doing so, it will first recall existing rules and principles addressing protection of the marine environment, primarily those included in the United Nations Convention on the Law of the Sea (UNCLOS). It will then highlight gaps in regulation which compromise the ability of the international community to effectively address threats to biodiversity in ABNJ. It will then turn to ongoing negotiations at the United Nations (UN) to develop a legally binding instrument to address biodiversity in ABNJ. Lastly, the chapter will present some critical remarks concerning ongoing developments and their potential to ensure effective protection.

2 The Law of the Sea and Protection of the Marine Environment

The international law of the sea contains numerous provisions concerning protection of the marine environment, including its biodiversity. Part XII of the UNCLOS, in particular, is dedicated to the protection and preservation of the marine environment and is complemented by numerous treaties adopted by States at the global and regional levels.[5]

Art. 192 UNCLOS sets the general principle, according to which "States have the obligation to protect and preserve the marine environment." As the International Tribunal for the Law of the Sea (ITLOS) has clarified, this duty both includes "the positive obligation to take active measures to protect and preserve the marine environment, and by logical implication, entails the negative obligation not to degrade the marine environment".[6] The duty contained in Art. 192 UNCLOS is not merely a hortatory provision or a policy statement but is an actual legal duty.[7] It concerns not only pollution of the marine environment, but

[4] This is a reflection of the global decrease in biodiversity. It has been estimated that around 1 million species already face extinction and that "there will be a further acceleration in the global rate of species extinction, which is already at least tens to hundreds of times higher than it has averaged over the past 10 million years" (IPBES 2019, p. 12).

[5] For a brief overview of the principal treaties concerning protection of the marine environment, see Boyle and Redgwell (2021), Chapter 7; for a comprehensive overview, see Harrison (2017).

[6] *The M/V 'Louisa' Case (Saint Vincent and the Grenadines v Kingdom of Spain)* (Merits), Judgment of 28 May 2013, para. 76; see also *The South China Sea Arbitration (The Republic of Philippines v. The People's Republic of China)*, Award of 12 July 2016, para. 941.

[7] Ibid.

also other forms of degradation and, more generally, the need to protect and preserve the marine environment in all its aspects and components.[8]

Part XII of the UNCLOS is mostly concerned with combatting pollution of the marine environment. Section 5 of Part XII contains a list of activities causing pollution that, at the time the Convention was negotiated and adopted, were of concern to the international community. These include pollution from land-based sources,[9] pollution from seabed activities subject to national jurisdiction,[10] pollution from activities in the Area,[11] pollution by dumping,[12] pollution from vessels,[13] and pollution from or through the atmosphere.[14] Nonetheless, States also have the duty to address other sources of pollution which are not expressly mentioned in the UNCLOS, should they become aware of their existence. This is clear from the language of Article 194(3), which refers to "all sources of pollution of the marine environment" and uses the words "*inter alia*" to introduce an illustrative list with four items. The attention being paid to noise pollution (Dotinga and Elferink 2000; Gillespie 2007; Papanicolopulu 2011) and plastic pollution (Prata 2018; Schmalenbach and Pleiel 2019) in recent years, and the discussions that have developed, confirm this point.

Notwithstanding its focus on pollution, the UNCLOS also contains broader provisions. Art. 194(5) UNCLOS, in particular, requires States to adopt those measures that are "necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life". This provision is often identified as the legal basis for the adoption of measures to protect marine biodiversity, including through the establishment of Marine Protected Areas (MPAs).

In protecting the marine environment and its biodiversity, States must take both individual and joint measures. Individual measures include the duty to prevent transboundary pollution of the marine environment[15] and the duty not to transfer damage or hazards or transform one type of pollution into another.[16] When unilateral action is not sufficient to address a certain source of pollution, or when joint action could optimise efforts and reduce costs, States may have an obligation to cooperate, as further detailed in Art. 197 UNCLOS. The duty to cooperate may take the form of a duty to notify all potentially affected States of the fact that "the marine environment is in imminent danger of being damaged or has been damaged by pollution",[17] to adopt joint contingency plans,[18] or to develop international rules and standards, as required by the provisions contained in Part XII, Section 5, of the UNCLOS.

Finally, in order to understand the scope and limits of the duties to protect the marine environment and prevent pollution, it is necessary to consider that these are "due diligence" duties. According to the ITLOS Seabed Disputes Chamber (SDC), a due diligence obligation 'is not an obligation to achieve, in each and every case, the result [envisaged by the norm]. Rather, it is an obligation to deploy adequate means, to exercise best possible efforts, to do the utmost, to obtain this result'.[19] As a consequence, States are required to take measures not only when pollution is due to their own activities, but also when pollution is due to the activities of other—often private—actors. The SDC has, in fact, noted that

[8] *Chagos Marine Protected Area Arbitration (Mauritius v. United Kingdom)*, Award of 18 March 2015, para. 320.
[9] Art. 207 UNCLOS.
[10] Art. 208 UNCLOS.
[11] Art. 209 UNCLOS.
[12] Art. 210 UNCLOS.
[13] Art. 211 UNCLOS.
[14] Art. 212 UNCLOS.
[15] Art. 194(2) UNCLOS.
[16] Art. 195 UNCLOS.
[17] Art. 198 UNCLOS.
[18] Art. 199 UNCLOS.
[19] *Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area*, Advisory Opinion of 1 February 2011 (SDC Opinion), para 110. See also *Request for an advisory opinion submitted by the Sub-Regional Fisheries Commission*, Advisory Opinion of 2 April 2015 (2015 Opinion) para 126–129. On due diligence obligations generally, see Ollino (2021). On due diligence in the law of the sea, see Konig (2018), Caracciolo (2018) and Papanicolopulu (2020).

due diligence obligations arise out of the necessity to control activities carried out by non-State actors,[20] and that they are distinct from 'direct' obligations of States.[21]

While due diligence obligations are flexible, international judges have identified a certain number of actions that are relevant in assessing compliance with a due diligence obligation: the adoption of laws and regulations;[22] the taking of administrative measures;[23] the exercise of a 'certain level of vigilance in their enforcement and the exercise of administrative control';[24] the enactment of enforcement measures, including 'boarding, inspection, arrest and judicial proceedings';[25] the proper marking of vessels;[26] the creation of monitoring mechanisms;[27] the investigation of any alleged violation and the duty to inform the affected State of the results;[28] the provision of sanctions 'sufficient to deter violations and to deprive offenders of the benefits' accruing from their illegal activities.[29] From a substantial perspective, the SDC has stressed the link between due diligence obligations and the precautionary principle/approach,[30] and also their connection with the duty to conduct an environmental impact assessment (EIA).[31]

In conclusion, the international legal framework provides for overarching principles that impose a duty on States to protect marine biological diversity, including that in ABNJ, to take all necessary measures according to their capabilities, and to cooperate when individual action cannot achieve the intended aim. However, this framework affords little mention to specific measures that States must adopt, or to mechanisms for ensuring cooperation between them.

3 Gaps in Regulation

All the rules illustrated above seek, directly or indirectly, to protect the marine environment, including marine biodiversity. However, as an analysis of them shows, these rules, with the possible exception of Art. 194(5) UNCLOS, do not specifically deal with protection of biological diversity, nor are they specifically applicable in ABNJ. This gap in regulation is only partially filled by other treaties. Two types of treaties are relevant: those that address biodiversity generally, on the one hand, and those that deal with specific marine regions, on the other.

The main global treaty is the Convention on Biological Diversity (CBD), adopted in 1992.[32] The CBD provides a comprehensive framework for protecting biological diversity and sets out key principles for State action in this regard. It comprises procedural rules aimed at minimising adverse impacts on biological diversity, including impact assessment,[33] and rules on access to genetic resources, including the fair and equitable sharing of benefits deriving from these.[34] Furthermore, States parties to the CBD have developed scientific guidance to identify Ecologically or Biologically Significant Marine Areas (EBSAs), many of which include portions of ABNJ.[35] Unfortunately, however, the CBD is of little use in protecting marine biodiversity in ABNJ, since

[20] SDC Opinion, para 112.

[21] SDC Opinion, para 121. See also 2015 Opinion, para 128; *South China Sea* (n 6), para 944.

[22] SDC Opinion, para 119.

[23] SDC Opinion, para 119; 2015 Opinion, para. 119.

[24] SDC Opinion, para 115.

[25] 2015 Opinion, paras. 104–105.

[26] 2015 Opinion, para. 137.

[27] 2015 Opinion, para. 138.

[28] 2015 Opinion, para 139.

[29] 2015 Opinion, para. 138.

[30] SDC Opinion, para 131.

[31] SDC Opinion, paras 145 and 150. See also *South China Sea* (n 6), para 988.

[32] The CBD is complemented by two protocols, the Cartagena Protocol on Biosafety, adopted in 2000, and the Nagoya Protocol on Access and Benefit-sharing, adopted in 2010.

[33] Art. 14 CBD.

[34] Art. 15 CBD.

[35] CBD Decision IX/20 "Marine and coastal biodiversity", UN doc UNEP/CBD/COP/DEC/IX/20, Annex 1 "Scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats".

it expressly provides that it applies "[i]n the case of components of biological diversity, in areas within the limits of its national jurisdiction" only,[36] and EBSAs themselves are not backed by legal measures for their protection.

Some regional treaties adopted to protect specific sea basins have gone beyond the UNCLOS and the CBD and have incorporated rules expressly aimed at the protection of marine biodiversity, also in ABNJ. For example, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) contains the obligation to "take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected".[37] Parties to the OSPAR Convention have furthermore adopted rules to create marine protected areas (MPAs) in ABNJ.[38] Similarly, the 1995 Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA Protocol) contains the obligation for States parties to "protect, preserve and manage in a sustainable and environmentally sound way areas of particular natural or cultural values" and "threatened or endangered species of flora and fauna",[39] and provides for the creation of Specially Protected Areas of Mediterranean Importance (SPAMIs) also on the high seas.[40]

Measures adopted by way of regional treaties, however noteworthy, do not suffice to guarantee the effective protection of biological diversity in ABNJ. In fact, regional treaties do not cover the entire extension of the world's oceans, and vast expanses of marine waters fall outside these treaties. Furthermore, these treaties are generally ratified only by the coastal States of that specific region; for all other States, they are *res inter alios acta* and do not set out legally binding obligations.[41] As a consequence, States that are not parties to a regional treaty are not bound by protection measures adopted by the parties.

The lack of rules dedicated to the protection and preservation of marine biological diversity is further exacerbated by the general legal framework that applies to ABNJ. According to the law of the sea rules, ABNJ include the water column beyond national jurisdiction, which falls under the regime of the high seas,[42] and the seabed and subsoil beyond the external limit of the continental shelf, which constitutes the international seabed area ("Area").[43]

The basic principle that still applies on the high seas is the freedom of the high seas,[44] conceptualised by Hugo Grotius at the beginning of the seventeenth century (Grotius 1609). Freedom of the high seas is accompanied by, and indeed premised upon, the principle that grants the flag State of a vessel exclusive jurisdiction over that vessel.[45] As a consequence, it is only the flag State that can adopt measures with respect to activities undertaken by its vessels which may negatively impact biodiversity in ABNJ. However, the lack of uniform international standards, combined with the phenomenon of flags of convenience (Llácer 2003), make regulation by the flag State entirely insufficient to address threats to biodiversity.

A different legal regime was introduced by the UNCLOS concerning the Area. According to Art. 136, the Area and its resources are the common heritage of mankind, subject to the specific legal regime contained in Part XI of the UNCLOS. In

[36] Art. 4(a) CBD.

[37] Art. 2(1)(a) OSPAR Convention.

[38] OSPAR's Regulatory Regime for establishing Marine Protected Areas (MPAs) in Areas Beyond National Jurisdiction (ABNJ) of the OSPAR Maritime Area, OSPAR doc. OSPAR 09/22/1-E, Annex 6.

[39] Art. 3(1) SPA Protocol.

[40] Art. 9(1) SPA Protocol.

[41] In accordance with the well-known principle codified in Art. 34 Vienna Convention on the Law of Treaties.

[42] Art. 86 UNCLOS.

[43] Art. 1(1)(1) UNCLOS.

[44] Art. 87 UNCLOS.

[45] Art. 92(1) UNCLOS. While the latter principle has some limitations, these do not directly relate to the right to take measures to protect and preserve marine biodiversity in ABNJ.

particular, no State may exercise sovereign rights over the Area and its resources,[46] while all activities must be carried out for the benefit of mankind as a whole and must result in the equitable sharing of financial and other economic benefits derived from them.[47] However, the strict definition of "resources", which includes only mineral resources,[48] renders the common heritage of mankind regime inapplicable to marine biological diversity in the Area.

Both the high seas regime and that of the Area are therefore unsatisfactory with respect to biodiversity in ABNJ. The insufficiency of the current regime has become apparent in recent decades in relation to two issues in particular: access to marine genetic resources and the establishment of marine protected areas (MPAs) in ABNJ.

The protection of rare or fragile marine ecosystems, which are often hosts to significant biodiversity, had already been promoted by Art. 194(5) UNCLOS, although it contained no express mention of the establishment of MPAs. The need to create MPAs was, however, openly acknowledged in Agenda 21, which identified priority areas for protection,[49] and is included in regional treaties, including the OSPAR Convention and SPA Protocol mentioned above. Today, the creation of MPAs is considered a priority and Sustainable Development Goal (SDG) 14, target 14.5, requires States to protect ten percent of marine waters by means of MPAs by 2020.

While the need to establish MPAs, also in ABNJ, has become increasingly clear, the legal complexities of such a process have not diminished. The fact that no State exercises exclusive jurisdiction on the high seas implies that no State can unilaterally adopt and implement measures to create an MPA that would have a binding effect on all other States. In particular, no State may exclude or limit the transit and activities of vessels flying foreign flags on the high seas, nor may it regulate other activities that might have an impact upon biodiversity. It is thus necessary to rely on international cooperation in order to create MPAs on the high seas.

Currently, some international organisations have a mandate to establish protected areas on the high seas. These MPAs, however, are subject to important limitations, due either to the membership of the organisation or to the limits to the organisation's mandate (Freestone 2018). For example, the MPAs that can be created under the OSPAR and SPA Protocol, mentioned above, are actually only applicable, as a matter of law, to the parties to those agreements. The International Maritime Organization (IMO) can adopt Particularly Sensitive Sea Areas (PSSAs),[50] which, due to the global membership of the IMO, apply to virtually all States. However, PSSAs address only pollution from vessels, because of limits to the IMO's mandate. Since the high seas are open for the use of all States, it is clear that only a global agreement could provide a stable legal basis for the creation of MPAs in ABNJ. This gap in legal regulation has brought to the fore the need to develop new legal instruments and rules to regulate how MPAs, applicable to all States, could be created on the high seas.

Another issue that has polarised the attention of States concerns access to and exploitation of marine genetic resources in ABNJ (Leary 2007; Kirchner-Freis and Kirchner 2014; Mossop 2015). Bioprospecting activities carried out by private actors in ABNJ and the subsequent patenting of genetic material recovered from ABNJ ignited a debate within the international community concerning the legal regime that regulates access to and exploitation of marine genetic resources in ABNJ.[51] Genetic material from ABNJ may have a high commercial value and at the same time is often difficult to access.

[46] Art. 137(1) UNCLOS.

[47] Art. 140 UNCLOS.

[48] Art. 133 UNCLOS.

[49] Agenda 21 - Global Programme of Action on Sustainable Development, UN doc. A.CONF/151/26, para. 17.85.

[50] IMO Res. A.927(22) Annex 2.

[51] CBD SBCTTA, Study of the relationship between the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea with regard to the conservation and sustainable use of genetic resources on the deep seabed, UN doc. UNEP/CBD/SBSTTA/8/INF/3/Rev.1.

This has meant, in practice, that only few companies from very few States have the technical capacity to access and use this material. Economic and other benefits deriving from it, therefore, are unequally distributed at the global level.

This picture is due, to a significant extent, to the gaps that exist in the current legal framework (Scovazzi 2010). While some interpret freedom of the high seas as freedom to access and exploit marine genetic resources located in the water column beyond national jurisdiction, others contest this understanding. As to resources on or under the seabed beyond national jurisdiction, two theories have been advanced. According to the first, mostly supported by developing States, these resources fall within the regime of the Area, regulated in Part XI of the UNCLOS, which states that the resources of the Area are the common heritage of mankind and establishes a complex legal and institutional framework regulating access to and exploitation of these resources. According to the second theory, the letter of Art. 133(a) UNCLOS excludes living resources from the regime of the Area; consequently, these fall under the freedom regime applicable on the high seas. Disagreement between the two groups of States formed the basis for the developments that currently characterise action by the international community.

4 Towards a New Treaty on Marine Biodiversity in ABNJ

The important economic and political issues raised by exploitation of marine genetic resources in ABNJ prompted the UN to take action and address the gaps in the current rules governing marine biodiversity in ABNJ. In 2004, the United Nations General Assembly (UNGA) created the Ad hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction (BBNJ Working Group).[52] In 2011, the BBNJ Working Group recommended to the UNGA that a process be initiated to ensure the conservation and sustainable use of marine biodiversity in ABNJ "by identifying gaps and ways forward, including through the implementation of existing instruments and the possible development of a multilateral agreement" under the UNCLOS.[53] In 2015, the UNGA convened a Preparatory Committee (PrepCom) with the aim of developing recommendations regarding a draft text for a legally binding instrument on biological diversity in ABNJ.[54] The PrepCom submitted its recommendations to the UNGA in September 2017, on the basis of which the UNGA decided to convene an Intergovernmental Conference (IGC).[55]

The IGC is tasked with developing an international legally binding instrument under the UNCLOS on the conservation and sustainable use of marine biological diversity of ABNJ.[56] The IGC's mandate includes the following four issues: "marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity-building and the transfer of marine technology".[57] The IGC has so far held three sessions. The fourth session, which was to be the final session, was originally sched-

[52] 'Oceans and the Law of the Sea', UNGA Res 59/24 (17 November 2004) UN doc. A/RES/59/24, para 73.

[53] 'Oceans and the Law of the Sea', UNGA Res 66/231 (24 December 2011) UN doc. A/RES/66/231, Annex – 'Recommendations of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction'.

[54] 'Development of an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction', UNGA Res 69/292 (6 July 2015) UN doc. A/RES/69/292.

[55] "International legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction", UNGA Res 72/249 (24 December 2017) UN doc. UN A/RES/72/ 249.

[56] Ibid, para 1.

[57] Ibid, para 2.

uled for 2020, but was postponed due to the Covid-19 crisis.[58]

From a formal point of view, the decision to aim for a legally binding instrument, i.e. a treaty, is noteworthy. At a time when much of international law, including law of the sea, is developed through the use (and abuse) of soft law instruments (Klein 2022), the option to have a hard law instrument to address protection of marine biological diversity in areas beyond national jurisdiction is a clear sign of the international community's determination to address the topic.

At the same time, the fact that the new instrument will be a binding treaty under international law presents some challenges, which are likely to affect both the negotiating process and the effectiveness of the treaty itself, once it is adopted. While the latter point will be developed in the next section, it is worth mentioning here that the new treaty will need to be coordinated not only with the UNCLOS and the CBD, but also with all other global and regional treaties and international bodies that have a bearing on biodiversity protection or activities that may impact biodiversity. Furthermore, the effects of the new treaty on non-parties should be considered (Ma and Zhou 2021). A treaty only becomes binding once it enters into force,[59] and for this to happen it must be accepted by a certain number of States. A successful conclusion of the IGC negotiations should produce a treaty which is not only good in itself, but one which is also acceptable to the States who will be called to ratify it. Given its global scope, the new treaty should be ratified by the vast majority of States, if not all, in order to be effective.

From a substantial point of view, the IGC's mandate includes not only the above-mentioned issues of marine genetic resources and MPAs, but also EIAs and capacity building and technology transfer. The inclusion of EIAs derives from the fact that regulation of marine genetic resources and MPAs, alone, is not sufficient to ensure protection of biological diversity in ABNJ. Access to and exploitation of genetic resources is only one of many activities that may have an impact on marine species in ABNJ. Moreover, even if a significant number of MPAs, including MPA networks, were to be established, these would certainly not cover the entire space included in ABNJ and would leave significant areas without protection. It is therefore necessary to consider all human activities carried out anywhere within ABNJ, in order to evaluate whether they might produce adverse effects upon biodiversity. Hence the need to provide for mandatory EIAs in cases where human activities might significantly compromise the integrity of marine ecosystems.

The last element of the package relates to capacity building and technology transfer. This topic, of particular concern to developing States, was previously discussed in the UNCLOS negotiations, resulting in Part XIV of the UNCLOS on "Development and Transfer of Marine Technology". However, this part has often been regarded as one of the parts receiving least attention. Hence the new call from developing States, during the preparation for the IGC, to include the topic within the IGC mandate. Furthermore, since access to and use of marine genetic resources is largely dependent on available technology, developing the capacities of all States and providing them with the technologies required to undertake bioprospecting and exploit genetic material would level the playing field and would allow all States to reap the benefits of marine genetic resources.

The four issues to be addressed by the IGC are considered a package, since the UNGA has tasked the Conference with addressing them "together and as a whole".[60] This means that, in order for the negotiation to be successful, all four issues must be addressed to the satisfaction of the participating States. The basis for this decision is

[58] The fourth session is now scheduled for March 2022; there are doubts, however, as to whether it will be the final one; see 25(218) *Earth Negotiations Bulletin* (2 September 2019) at <https://enb.iisd.org/download/pdf/enb25218e.pdf>.

[59] Art. 24 VCLT.

[60] This was the procedure adopted already in the Third United Nations Conference on the Law of the Sea, which produced the UNCLOS.

that the importance of each topic differs for the various States involved. For example, while developed States, driven by civil society organisations, place more emphasis on the need for a network of MPAs, developing States consider that it is crucial to have a legal regime on marine genetic resources that will allow them to access these resources and reap the benefits deriving from them. The package deal option would therefore give each group of States some bargaining power, with a view to reaching a compromise that could be transferred into the new treaty.

5 The Beginning of a Process

The international community appears to have understood the significance of marine biological diversity in ABNJ and the multiple threats that endanger it. The decision of the UNGA to adopt a treaty that will fill gaps in the law of the sea, as well as the ongoing negotiations within the IGC, testify to the willingness of States to address these issues, and to do so using binding legal instruments. At the same time, there are still a number of factors which might delay and potentially jeopardise current efforts. Some factors are internal to the negotiation, while others are external (Papastavridis 2020).

Within the IGC process, it is worth highlighting that, after over fifteen years of preparatory work and three years of formal negotiations, the positions of some States are still far apart. Developed States continue to push hard for the establishment of a system of MPAs on the high seas, yet do not seem particularly willing to make concessions on marine genetic resources and technology transfer. The numerous alternatives still present in the draft negotiating text also bear witness to this distance between States.[61] If no compromise is found concerning marine genetic resources, the negotiation as a whole is unlikely to reach a successful conclusion.

In addition, the IGC's mandate, while consistent, may not prove sufficient to truly guarantee the protection and preservation of marine biological diversity in ABNJ. Although the four elements of the package do, in fact, cover some key aspects of biodiversity protection, they do not exhaust the topic, since there are further issues of concern. It will suffice to mention 2020) climate change, including warming of the oceans and ocean acidification,[62] both of which have detrimental effects on marine species. While MPAs may contribute to dealing with climate change (Smith 2020), they are by no means the solution to the problem. Comprehensive protection of biodiversity, including in ABNJ, cannot leave climate change out of the picture, even if the origins of this phenomenon are mostly to be found on land.

Turning to external factors, these relate not only to contingent problems, above all the Covid-19 crisis, which has delayed negotiations, but also to limitations of international law as a legal system, and to deeper issues, concerning in particular the method adopted to address issues pertaining to ABNJ.

The decision to seek to adopt a treaty, rather than a soft law instrument, is certainly evidence of serious intent and actually the only option available, in the absence of rules of customary international law. However treaties, which are one of the main sources of international law, raise some issues when called on to address global and pressing challenges. A treaty is only binding once it has entered into force and only on those States that have accepted it. There is likely to be a certain time lag between adoption of the new treaty and its entry into force, and even when it does come into force, it will not be immediately binding on all States. Private actors might exploit this fact and opt for the nationality of non-parties,

[61] Draft text of an agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, UN doc A/CONF.232/2019/6.

[62] SDG 14 Target 14.3 requires States to "minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels".

so as to bypass legal obligations concerning protection of biodiversity in ABNJ.

More broadly, the current paradigm, which is still premised on the principle of freedom of the high seas and exclusive flag state jurisdiction, has proven unsatisfactory in successfully addressing the many challenges posed by human activities on the high seas. Even if the new treaty were to be adopted, enter into force, and be ratified by a sufficient number of States to ensure its generalised application, it would still be difficult to effectively monitor the high seas and enforce the treaty's provisions. Exclusive flag state jurisdiction, combined with the widespread use of flags of convenience and the ease with which a vessel can be reflagged, even when it is navigating the high seas, facilitate the avoidance of rules and the persistence of deplorable, albeit not entirely unlawful, conduct.[63]

This phenomenon is well-known in other fields, in particular efforts to address Illegal, Unreported and Unregulated (IUU) fishing on the high seas (Palma et al. 2010; Rosello 2021). It is only through the combined action of law-making, law enforcement and economic and political sanctions that States have achieved a certain level of success in curbing IUU fishing. Lessons might be learnt from that field, but always keeping in mind the peculiarities of biodiversity protection.

In conclusion, it is still too early to advance any meaningful considerations on the capacity of the ongoing IGC and the future treaty to effectively address biodiversity protection in ABNJ. Two facts do, however, seem clear. First, regardless of the outcome of the IGC, existing rules, instruments and bodies will still have a role to play in ensuring protection of marine biodiversity in ABNJ (Ardron et al. 2014). Second, successful conclusion of the IGC would be a major milestone, but it would by no means be the end of the process, which would need to continue in order to ensure that marine biological diversity in ABNJ is effectively protected.

[63] Reform has already been suggested by scholars, e.g. Geiss and Tams (2015).

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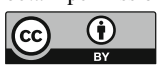

Climate Change and the Ocean: The Disruption of the Coral Reef

Fabio-Massimo Battaglia

Abstract

Even though coral reefs represent a negligible percentage of the ocean floor, they are wardens of incredible biodiversity. They provide support for at least 500 million people with food security and livelihoods, mostly in poor or developing countries.

Despite their importance, coral reefs are also extremely fragile. They are among the most damaged and threatened ecosystem due to unprecedented global warming, ocean acidification and climate changes, combined with increasing local pressures. These incredible ecosystems are calling us into action towards more efficient protection to ensure their conservation and restoration.

Keywords

Biodiversity · Biomimicry · Climate change · Coral reefs · Community-based approach · Restoration

1 Introduction

If we listen to the David Bowie song 'Space Oddity', Major Tom tells ground control that "Planet Earth is blue and there is nothing I can do". Fortunately, this is not the case for us. We can do something, and we should.

Oceans cover almost 70% of the Earth's surface. They are the most productive ecosystem, housing the vast majority of all known species. This unequalled habitat plays a crucial role in regulating global temperature and controlling our climate and weather patterns. The oceans are the primary producer of oxygen, and they also absorb large amounts of carbon dioxide.

Even though coral reefs represent a negligible percentage of the ocean floor—less than 1%—they are wardens of great biodiversity, more so than any other habitat. These reefs harbour a quarter of all marine life, and they provide support for at least 500 million people with food security and livelihoods, mostly in poor or developing countries. Furthermore, at a time when rising sea levels suggest that there is a real risk of small islands and atolls disappearing, it is essential to highlight how coral reefs play a pivotal role in protecting the coastline from floods and additional harm. These reefs protect shorelines by dissipating the force of the waves and floods, thereby helping to preventing loss of life, property damage and erosion.

Unfortunately, despite their importance, coral reefs are also extremely fragile. They are among the most damaged and threatened ecosystem due to unprecedented global warming, ocean acidification and climate changes, combined with increasing local pressures.

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Coral reefs are seriously threatened by climate change, and we cannot ignore this. In recent years, due to the mounting anthropogenic pressure from pollution and over exploitation alongside the rise in the global temperature, coral reefs around the world have suffered mass coral bleaching events that increase their vulnerability. Coral reefs are dying, and if we continue to act as normal, the vast majority of coral reefs will cease to exist by the end of this century.

The only way to avoid this scenario and ensure the survival of coral reefs is to maintain the global average temperature well below 2 °C above pre-industrial levels. Doing so would make it possible to improve coral reef living conditions in addition to introducing other measures to preserve, rescue and restore them. Such other measures alone would not be sufficient, as they cannot save coral reefs unless GHG emissions are also limited.

These incredible ecosystems are calling us into action towards more efficient protection to ensure their conservation and restoration.

What consequences would the loss of coral reefs have? What can be done to protect this heritage for which we are responsible? By answering these questions, this chapter also aims to analyse how the international environmental legal framework is acting to support and improve the conservation of coral reef ecosystems. We will also consider whether the current environmental treaty rules are sufficient to meet this challenge or whether it is necessary to change the paradigm and our perspective on nature and biodiversity. Moreover, it will also be essential to reflect on creative solutions that embrace a new perspective, based on sustainability and the coexistence of man with the environment. It is impossible to think about safeguarding our planet's biodiversity without considering economic, social and technological development and the dynamics of this.

2 An Incredible Ecosystem

The oceans are already interesting and productive ecosystems, which host, within them, incredible wonders, and a large amount of biodiversity. They are often identified as the blue lung of the Earth; they cover much of our planet and represent our greatest resource. As mentioned before, the Oceans play a notable role in regulating global temperature and governing our climate and weather patterns. Furthermore, they are the primary producer of oxygen, and they also absorb large quantities of carbon dioxide. None of this, however, conveys the full extent of their importance. In this vast ocean environment, the smallest but surprisingly crucial asset is coral reefs.

Without going too far into matters that are beyond the scope of this work, it is, however, interesting to note how coral reefs are composed. Coral reefs are complex structures that have been formed over thousands of years due to the deposition of calcium carbonate skeletons of coral species that form the reef. The coral is an organism belonging to the Anthozoans, small polyps of a few millimetres in size grouped in colonies that can belong to over five thousand different species. These polyps live in symbiosis with the underlying unicellular algae, which give the coral formation its characteristic colour. It is these algae that have the function of carrying out photosynthesis and producing nourishment for the coral polyps (Creary 2013).

There are several species and different kinds of corals; they can be found in deep water and also in the shallow waters surrounding the ocean environment. However, it is essential to distinguish between corals in cold or warm water (Goodwin 2006). For this study, we will focus only on warm water corals, which are common in the coastal tropical areas, and which make up the reefs covered by this chapter.

Finally, it is critical to highlight that while it is difficult for this type of coral to persist in low temperatures, coral reef-building in shallow tropical marine areas is only possible where the water temperature is between 18 and 30 degrees centigrade (Hoegh-Guldberg 1999). Therefore, the temperature of the water is a crucial aspect for the survival of the entire coral reef ecosystem.

Why are coral reefs important, and what is the issue? As mentioned before, coral reefs represent one of the richest ecosystems in terms of

biodiversity. Although they occupy only a very small portion of the ocean surface, coral reefs are home to more than a quarter of all fish species and marine animals. Furthermore, coral reefs provide a wide variety of ecosystem services and benefits for the populations living close to them. They are indeed not only a source of subsistence food but also protect coastal areas from floods, as well as supporting the fishing and tourism industries.

Coral reefs are considered to directly support more than 500 million people by giving them the minimum subsistence for survival (IUCN 2017). This figure is even more important if we consider that most of these people live in poorer or developing countries. Thus, given this huge number of people from different cultures who rely on coral reefs, it is easy to understand how the disappearance of this type of ecosystem would have a severe impact not only in environmental terms but also at the economic, social and cultural level.

It may also be useful to point out that coral reefs are seen as a prime indicator of the health of the global environment. Since they are a very sensitive ecosystem, they react very quickly to climate change, pollution and anthropogenic stress. For this reason, they are considered an alarm bell, showing us what could happen to other less sensitive systems. If climate change is not urgently addressed, the deterioration of other systems could unfold more rapidly and irreversibly (IUCN 2017).

3 A Critical Issue

Coral reefs around the world are suffering. Recently there has been much discussion about the risks and dangers for the future of coral reefs. We are witnessing increasingly frequent coral bleaching events; but what do these events mean and what are the causes?

Anthropogenic climate change is putting coral reefs under pressure; greenhouse gas emissions have caused a rise in the global surface temperature and increased acidification of the oceans.

These facts, in addition to growing local pressure, have led to unprecedented mass coral bleaching events, which have made coral reefs one of the most endangered ecosystems on the planet.

Coral bleaching occurs when the water temperature is too high and this has a negative effect on the symbiosis between polyps and algae. The latter are expelled, and the polyps are deprived of their nourishment. When these conditions last for an extended period, the polyps die, and the absence of algae turns the coral structures white. Coral bleaching events often lead to the death of large numbers of corals. Moreover, other types of algae can take over a damaged reef and create a different new environment where the growth of new corals is more difficult.

Dead corals are rapidly destroyed by marine erosion, which is no longer retarded by the production of new calcium carbonate. Furthermore, the death of polyps damages the food chain, with repercussions for the marine fauna of the entire coral ecosystem (Heron et al. 2017).

The consequences for the human population and the economy can also be devastating. As we have seen, in many areas of the world, especially in poor and developing countries, subsistence activities such as fishing or tourism depend heavily on coral reefs. Furthermore, the loss of these structures reduces the natural defence against coastal erosion from floods and destructive storms associated with extreme weather events.

The first cases of bleaching were observed in the 1990s along the Australian Great Barrier Reef, after a warming of the Pacific waters due to the periodic climatic phenomenon known as El Niño.

Another critical phase occurred in 2010, but it was between 2014 and 2017 that these events began not only to last longer but also to be more extensive, as they affected over 70% of the world's coral reefs (Heron et al. 2017).

The vast majority of the reefs around the world have suffered from mass bleaching events with devastating effects. Overall, it is estimated that almost 50% of the world's corals have been lost in the last thirty years. Some authors fear that only 10% of those still existing in the world will survive beyond 2050, and by the end of this century

we could permanently lose this incredible ecosystem (Obura 2017).

These catastrophic data indicate that we are no longer facing only periodic fluctuations in ocean temperatures linked to El Niño, but slow and inevitable rises in seawater temperatures, produced by global warming.

The bleaching of corals and their ultimate death due to heat stress that has been observed over the past three decades is expected to continue and intensify over the next few decades unless GHG emissions are dramatically reduced (Heron et al. 2017). Unfortunately, corals cannot survive the frequency of current bleaching events, and ocean acidification due to the high level of GHG emissions is continuing to increase. The first global scientific assessment of climate change impacts on World Heritage coral reefs—published in 2017 by UNESCO—highlights that if humans continue to act under a business-as-usual scenario bleaching events will increase in intensity and frequency. The consequence will be that almost all coral reefs in the World Heritage sites would cease to exist as functioning coral reef ecosystems by the end of this century (IUCN 2017).

4 What Are We Doing?

Fighting coral bleaching is one of the priorities on the international agenda. In order to contain the increase in global average temperature between 1.5 and 2 °C compared to pre-industrial levels, the path is to drastically reduce GHG emissions by the second half of the century, as set out in 2015 by the Paris Agreement. On one hand, achieving this goal is crucial since it provides the only chance for the survival of coral reefs globally. On the other hand, the same goal is now considered unattainable by many scientists, for several reasons. The first of these is that time is not on our side and we are still far from reaching our goal. We need to act immediately and with more ambitious measures. Secondly, the current rules of the world market are in stark contrast to a sustainable view of the economy, and even at the local level, this is a severe problem. The increase in local populations, resource consumption and economic activities, such as fishing or tourism, will inevitably damage the state of the ecosystem. A radical change in the economic vision would be needed (Aldred 2019).

Suppose the goal of the Paris Agreement is fully reached. In that case, we will obtain a decrease in atmospheric carbon concentrations that will lead to better conditions for the survival of coral reefs and enable other measures to rescue them to be successful. It is evident that a single solution is not enough; on the contrary, we need a synergy of measures and policies aimed at the conservation and safeguarding of coral reefs. For this reason, some research centres are trying to intervene directly on corals, with various measures of repopulation or restoration of the reefs.

These techniques, however, have some limitations. In addition to being expensive, they can only be applied on a tiny scale, while the risk to coral reefs concerns large areas of the oceans. Furthermore, it is essential to highlight that none of these techniques is currently able to recreate the ecological functions of a coral reef. Thus, even if the corals can be recreated, it is not possible to reactivate the ecosystem (Aldred 2019).

Support and restoration of coral reefs should be treated as a complementary measure to the achievement of the objectives of drastically reducing emissions and changing the economic paradigm. Long-term investments should, therefore, be made to support research for the restoration of barriers to overcome the current difficulties (IUCN 2017).

The Paris Agreement is not the only tool that the international community has adopted to tackle climate change and its adverse effects. The whole international agenda aims to create a more sustainable society, a new economic perspective that involves all human activities. Human development, which must be achieved through the goals of sustainable development, should take into account an integral ecology that cannot separate human and social development, through the eradication of poverty, from the protection and safeguarding of the environment.

So, the objectives established with the Paris Agreement are also present and reinforced in other international and regional agreements, in local policies and other instruments such as the UN Sustainable Development Goals (SDGs).

Among the SDGs, there are some that—at least partially—cover the theme addressed in this chapter.

It could be useful to consider two different groups of SDGs. The first group is composed of Goals 8 and 12. Both of these goals concern the transformation of the economic system, to promote a circular economy that fosters inclusive and sustainable growth as well as sustainable consumption and production patterns. In the last part of this work, we will deal with the aspect of the economic system and its transformation to a system that rapidly reduces greenhouse gas emissions to ensure global temperature decrease, and a new economic perspective that takes into account the benefits and the services provided by the ocean and the coral reefs (United Nations General Assembly 2015, goals 8–12).

The second group is based on Goals 13 and 14. Goal 13 is a general goal aimed at fighting climate change. It seeks to promote action, at all levels, from local to global, to combat climate change. It highlights how climate change is a global issue that knows no national borders, but at the same time, that not all countries are affected in the same way and with the same intensity. This point is interesting because the countries most directly affected by the coral reef crisis are often the poorest or the developing countries. These countries have contributed minimally to anthropogenic climate change, and yet they are the most affected by it. The resources of these countries are limited; there is a need to promote common actions, in a shared effort by all the players on the international stage. Goal 14 is directly focused on the ocean ecosystem. It concerns the conservation and sustainable use of the oceans, seas and marine resources for sustainable development. Therefore, it is obvious how important the protection of coral reefs is for this SDG since—as mentioned in the previous part of this work—they represent the most outstanding heritage within the ocean ecosystem.

Among all the objectives proposed by SDG 14, there is one in particular that aims to increase the economic benefits to small island developing states by 2030, by resorting to more sustainable use of marine resources, including sustainable management of fisheries and tourism (United Nations General Assembly 2015, goals 13–14). To do this and to preserve the coral reef, these countries need to receive technological support from developed countries. This kind of alliance between states can overcome local difficulties in the move towards a more sustainable economy.

Another exciting tool within the international community is the UN Decade on Ecosystem Restoration. This programme, established by the UN General Assembly in 2019, aims to dramatically increase the restoration of degraded and destroyed ecosystems through targeted and agreed actions at global, regional and local levels. The aim of these measures is to fight the climate crisis and improve food security, water supply and biodiversity and, at the same time, ensure human development and the sustainable exploitation of natural resources. The programme will help countries to take action against the harmful effects of climate change and biodiversity loss, promoting rapid and effective restoration policies that build resilience, reduce vulnerability and increase the ability of ecosystems to adapt to daily threats and extreme events (Eisele and Hwang 2019).

The Sixth Status of Corals of the World Report—recently published on 5th October 2021 by the Global Coral Reef Monitoring Network (GCRMN)—highlights the current status of coral reefs worldwide, analysing their trends and potential future scenarios. One claim among the Report's key findings is crucial and straightforward: coral reefs are still in trouble, and we need to act now. The report points out that 14% of the world's coral reefs have been lost in the last decade. Many reefs are diminishing instead of flourishing, and coral bleaching is becoming a regular event rather than a rare damaging episode (GCRMN et al. 2021).

As previously described in this chapter, increasing coral bleaching events, higher ocean temperatures, and other climate change-related

impacts can drastically affect coral reefs, with severe and irreparable consequences.

Luckily, the report also points out some positive hopes and possibilities.

Indeed, given the right conditions, coral reefs can recover. There are already some good examples of resilience and natural resistance in dealing with increasing water temperatures. Thus, since healthy corals are more likely to adapt to climate change, the action needed for coral protection should focus on creating the proper conditions to help the natural recovery of the reefs. This could be, for example, by minimising human impacts, such as water pollution and overfishing, and slowing climate change. It is essential to work together with local communities to identify proper measures and good practices to keep coral reefs in good and healthy condition.

In order to increase awareness of this issue and to spread action among international actors and local communities, the GCRMN and the International Coral Reef Initiative (ICRI) published this report before the UN Climate Change Conference (COP26) held in Glasgow in November 2021.

Indeed, the ocean was one of the most important themes during COP26. World leaders, international organisations, civil society and NGOs demonstrated considerable interest in ocean challenges and opportunities, at both official meetings and side events. As is evident from the COP26 outcomes, there are intangible and complex links between the ocean, climate and biodiversity, and the need to address them jointly is on the international agenda.

This high level of mobilisation crystallised the importance of the ocean in the climate negotiations, and the importance of paying increasing attention to the maritime ecosystem and its protection.

Given this context, it is worth mentioning another interesting initiative in the international arena: the UN Decade of Ocean Science and Development 2021–2030. This initiative aims to bring together institutions, researchers, stakeholders and other actors in the ocean community to design and deliver proper solutions and development projects to support the Agenda 2030 in its path for a healthier Ocean.

Finally, the decision to hold COP27 in Egypt is also a good opportunity. The Egyptian government launched one of the earliest conservation initiatives in 1983 (Kleinhaus et al. 2020) and it has repeatedly reiterated the importance of protecting coral reefs. Hosting COP27 right on the shores of the Red Sea could represent an opportunity to encourage action in this sense.

5 What Can Be Done?

Despite the vast range of potential tools and the objectives that have been set, there is still a risk that we will fail to achieve the goals, or fail to do so within the necessary timeframe. According to an opinion shared among much of the scientific community, the emissions target set in the Paris Agreement is not ambitious enough, and even if we reach that goal, there will still be temperature increases by 2030. That could mean the end for the coral reefs. Another note concerns Goal 14 of the SDGs, which, it is suggested, should deal more specifically with the human impacts causing the destruction of coral reefs and their current situation, in order to consider faster and more efficient strategies between states (Manfrino 2017).

More aggressive and robust actions are required to face this issue, not only by states and the governments but also by other actors, such as local institutions, NGOs or the private sector. This paragraph will address the current situation in developing countries in order to identify some good practice and potential solutions.

While it is evident in any international agreement that there must be significant financial aid to help developing countries, it is also true that relying too heavily on this kind of help could be problematic for them.

Nowadays, it is becoming clear that climate adaptation costs will be higher than previously expected. This fact will probably lead to a lack of funding support and weakening international aid in the future.

Thus, governments in developing countries should act to prepare for this situation, and they

should be ready to decrease their dependence on foreign support (Clissold et al. 2020).

Obviously, the Principle of Common but Differentiated Responsibilities places western and developed countries in a position to help and, in some way, pay for their pollution. They should support poorer countries in achieving social and economic development and also in tackling the impacts of climate change. Financial aid and technological support are crucial in this challenge, but other factors must also be taken into account. For instance, the ability to act and to choose what is best for one's country also depends on cultural and social factors which differ from state to state. These factors can also influence adaptation policies. This explains why it is important to maintain an appropriate level of independence.

An analysis of the climate adaptation strategies used to date reveals that these have often been a failure, or at least inefficient or inadequate. This is primarily the case when the people living in a particular context have not been involved in the planning of the adaptation measure. A case in point is the building of sea walls and barriers in the Pacific region to protect low-lying states from floods and sea-level rise or to prevent coastal erosion. This could be a feasible solution in rich developed countries where appropriate technology and funding can be found. However, it may not be sustainable in small island developing states. Moreover, this solution does not take into account any cultural factors. These nations have been living alone in the oceans for centuries, and their traditional technologies might provide more suitable solutions. For instance, some nature-based measures, such as replanting coastal mangroves, can be more sustainable for the local society (Nunn and Kuman 2020).

Following on from this last point, it is worth mentioning the Community-Based Approach, a strategy to empower communities to prevent and face climate challenges. The aim of the strategy is to facilitate adaptation measures, creating inclusive, community-driven and sustainable actions that take into account the cultures and the tradition of the local community (Kirkby et al. 2015). The idea is to enable local communities to understand and foresee climate change impacts in advance and to plan and decide how to intervene. The local communities will choose their own strategies and methods to respond to the harmful effects of climate change, and they can independently plan their adaptation goals. This kind of programme is thoroughly planned and led by the local communities, without any external imposition. Hence, any social and cultural factors will not be neglected.

Taking—once again—the small island states of the Pacific as an example, it is easy to imagine that they have longstanding traditional knowledge of the ocean environment and also a generous legacy from their ancestors regarding the implementation of cashless adaptation actions. These rural communities could develop measures and solutions to tackle the impact of climate change that cost nothing and that are consistent with their cultures. This means starting from the bottom, through policies of education and involvement of the whole society.

These solutions might involve direct intervention on the environment using a small amount of money and little technology. Hence, there is no need to rely too heavily on the developed countries. Examples include actions related to traditional methods of planting and restoring the mangroves—as mentioned above—or similar solutions relying on resources available locally.

It is not only an issue of reducing costs but also a means of enabling rural communities to enhance their heritage and act directly on the environment that surrounds them (Nunn and Kuman 2020). It is essential to understand that the two different levels of action must be complementary. It is vital that we act internationally to change the way we live, produce and consume. However, it is also important to specifically engage the communities of developing countries, increasing their autonomy without creating dependence on foreign funding, which could run out quite quickly.

6 Blue Economy: A Sustainable Future for the Ocean

As we have seen, all the solutions and the objectives identified to tackle climate change and to save the coral reefs are related to economic and business interests. To meet the requirements of the Paris Agreement, and also to achieve the SDGs of the UN Agenda 2030, it is vital that we change our economic system, or—at least—understand that the benefit of preserving the coral reef ecosystem is not anti-economic. Indeed, we have seen how the coral reef is crucial for the economy of many countries.

At first glance, saving the environment runs contrary to the rules of our economy and mainstream trade and finance. It is easier to find business activities following the principles of the linear economy than those of the circular economy. This is no longer sustainable. Switching our economic system to become sustainable and circular must be the priority. It is the only way to achieve the goals we have set ourselves. It will dramatically decrease waste and emissions, and will involve governments finding policies and practices that follow the economic aims of the SDGs (Aldred 2019).

The first action might be to thoroughly understand the vast range of benefits that humanity gains from coral reefs. This chapter has shown how reefs play a crucial role in the economies of tropical countries. Coral reefs are one of the greatest assets for these nations, and governments should treat them as such, increasing the investment to preserve, sustain and restore them and the entire ecosystem (Obura 2017).

Related to this issue, in recent years, we have long heard of the blue economy—a model of an economic system that aims to revolutionise the world economy through a sustainable approach. The Belgian economist Gunter Pauli introduced the term blue economy (Pauli 2010) for the first time in 2010. As can easily be guessed, the term alludes to water—and the oceans represent its core—but it goes beyond this element. Pauli introduces a new type of sustainable economy, similar to the green economy but with a new crucial aspect: *biomimicry*. It is concerned with studying, and possibly imitating, nature in order to seek solutions to apply to human activities.

According to the Belgian economist, by studying how nature works, it is possible to improve production and processing techniques, thus creating new jobs, revitalising the economy and safeguarding the environment (IIED 2019). In short, it is possible to say that the blue economy seeks to eliminate emissions that harm the planet and to revolutionise production systems through biomimicry. Hence, this model of sustainable development has been continually promoted, in recent years.

As this chapter shows, coral reefs are an essential part of the blue economy, and we must therefore act and invest in preserving their productivity. If we do so, with proper investments and solutions, it will be possible to create a sustainable economy that enables both human development and environmental protection, preserving the heritage and the biodiversity of the coral reefs and preventing the harmful loss of this incredible ecosystem.

7 Conclusions

One important conclusion is that, in addition to states and international programmes, other actors can play a crucial role. As this study shows, developing countries need to stop relying totally on foreign support. Funds and financing projects often do not consider the cultures and traditions of indigenous peoples, who have a privileged relationship with the nature that surrounds them. NGOs and local actors can therefore be the missing link in the chain that protects this delicate ecosystem. Even if we assume that the objectives of the Paris Agreement will be achieved, it has been shown that without an ambitious change, even they may not be enough. That is where other actors come into play. Local adaptation and resilience policies can give an extra boost. Synergy between actions is needed, with different components of action against climate change complementing each other.

As mentioned above, coral reefs—and their conditions in the short term—are a clear indicator of our ability to revolutionise our lifestyle, promoting and implementing good practices to preserve the environment.

Collective action is needed because, as this chapter has shown us, even though coral reefs cover a tiny part of the ocean surface, they could change the fate of the entire planet and all humanity will benefit from their protection. Ultimately, we cannot think of living in a world that does not contemplate sustainable development. It is an indissoluble binomial; human and technological development cannot ignore the protection of the environment and its biodiversity.

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Marine Protected Areas as Tools for Ocean Sustainability

Emanuel J. Gonçalves

Abstract

Science is clear in showing that we are facing two existential challenges: a climate emergency and a species extinction crisis. These challenges are rooted in the extractive and linear economic model we have globally adopted, in which economic development is intertwined with the destruction of nature. Europe has recently responded politically by adopting the European Green Deal with a set of policies aimed at transforming the EU economy envisaging a future with no net carbon emissions and where economic growth is decoupled from resource use. Despite the dire state of the ocean and the urgency to implement effective solutions, we continue to witness the loss of nature and, with it, the loss of current and future economic and social value. Marine protected areas (MPAs) are one of the most effective solutions to address these challenges. There is, however, the need to clarify what these area-based management tools are, how they can provide benefits, what conditions must be met to ensure they are effective, and how a strategy can be adopted to increase the breadth, speed and success of efficient MPAs to save what is left in the ocean, allow ecosystems to recover, and build sustainable jobs and economic growth.

Keywords

Marine protected areas · Ocean governance · Benefits of protection · Science-based decisions · Stakeholder engagement · Government leadership

1 Introduction

We have today a solid scientific understanding of the environmental crises facing the ocean, supported by indisputable facts compiled in papers and reports such as those of the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Knowledge of the challenges and the science behind them places a demand on decision-makers and society to find solutions that can respond with the speed, scale and breadth needed to face these existential problems. Marine protected areas (MPAs) are known to be one of the most effective tools to protect what is left in the ocean, allow ecosystems to recover, and support nature-based solutions to the climate crisis. However, we currently have too few MPAs, and many do not work, preventing the ecological, social and economic benefits of protection from being fully delivered.

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This chapter will begin with a global assessment of the status of human impacts on the ocean and will identify the main causes of those impacts (Sect. 2). Solutions to those impacts will then be explored, focusing on MPAs and their definition and scope (Sect. 3). Subsequently, some key aspects of the functioning of MPAs will be covered, with emphasis on the conditions needed to guarantee the effectiveness and persistence of these conservation tools (Sect. 4). Next, some standards for designating, implementing and maintaining MPAs are presented, such as those of the International Union for Conservation of Nature (IUCN) and the new MPA Guide, with a view to discussing ways to increase the speed with which they are established, the extent of their protection and the success of their implementation (Sect. 5). Lastly, the chapter will discuss MPAs within the wider context of a 100% managed ocean (Sect. 6).

2 Ocean Sustainability: Status and Roots of the Problem

Science is clear in showing us that our societies are facing two environmental existential crises: a climate emergency (Pörtner et al. 2019) and a species extinction crisis (Díaz et al. 2019). Evidence of these crises has been made available to decision-makers, from politicians to business leaders, to ocean stakeholders, to managers and to the wider society, at an ever-increasing pace. Although the ocean is the least studied system on the planet, with a large portion of the seabed and the full extent of ocean biodiversity still unknown to science, an estimated 91% of marine species still undescribed and over eighty percent of the ocean floor as yet unmapped and unexplored (Mora et al. 2011), human impacts on the ocean are indisputable and their magnitude and extent is only now beginning to be understood by society.

In fact, until very recently, the ocean was seen as an inexhaustible source of food, and human activities were not perceived as being able to seriously disturb the functioning of marine ecosystems. We have even used the ocean as a deposit for some of our garbage, including dumping large quantities of radioactive waste in the deep sea, and we continue do to so now, with nutrients from agriculture and our city sewage systems, pollutants from our industries, and plastics and microplastics from our production systems.

The perception that the ocean is too big to fail still persists today in many management and policy contexts. This has consequences for the way we manage biomass extraction (fisheries) and production (aquaculture), non-living resource extraction (sediments and minerals), energy production (oil and gas, and renewables), and essentially any use in the ocean. In fact, in many cases we still consider the ocean to be fundamentally an open access space where our individual and collective "rights of use" should not be limited, forgetting the responsibility to protect and sustainably manage the "commons" that is the ocean space and the ocean life within it. Only now are we beginning to see a consensus on changing this view, which can be encapsulated in a "new narrative for the ocean" (Lubchenco and Gaines Steven 2019): neither too big to fail nor too big to fix, but rather too big to ignore.

The root of the challenges we are now facing lies in the fact that the global economic markets built post World War II considered marine natural resources essentially to be a free-to-take asset and regarded the impacts of extraction on ecosystems as an externality (meaning that the costs of those impacts are not being incorporated in the activities that exploit ocean resources). The consequences of this position are now clear to us, and the activity with the largest impact in the ocean is fisheries targeting wild animal species.

Globally, 90% of the world's fisheries are either fully exploited (61%) or overexploited (29%) (FAO 2020) and a mere 13.2% of the ocean can be considered to have intact ecosystems with low impact from human pressures (Jones et al. 2018). Up to a third of catches, worth up to $23 billion, are illegal, unreported, or unregulated (IUU) (FAO 2021). At the global scale, 55% of the ocean area is used for industrial fishing and the fishing fleet increased from 1.7 to 3.7 million vessels between 1950 and 2015. Some fish groups are particularly impacted

by this often unregulated or poorly regulated activity, namely large predatory fish that play a central role in the functioning of marine systems and, in particular, sharks. In fact, since the 1970's, the abundance of shark populations has declined 71% (Pacoureau et al. 2021), with an estimated 100 million sharks being caught each year, and the biomass of many large predatory fish is today only around 10% of pre-industrial levels (Myers and Worm 2003). Even some whale populations, which are often considered safe following the industrial whaling ban agreed in the 1940's, are today a mere fraction of their pre-whaling abundance with some species such as the blue whale, the largest animal ever to occur on Earth, at levels of around 10% their historical size.

On top of this, human activities are also polluting the ocean. 5 to 12 million metric tons of plastic enter the ocean every year, noise and chemical pollution impact many marine species, and nutrient inputs such as nitrogen and phosphorus cause hypoxia, harmful algal blooms and an increase in eutrophication phenomena and dead zones. Several of these impacts have cumulative and synergistic effects on marine live, many of which are still unknown today.[1]

The message is therefore clear and simple: we are destroying the planet and we know why.

3 Why We Need Marine Protected Areas to Achieve Ocean Sustainability

Given that the message is clear—we have a problem, and we know what is causing it—the logical question that follows is how to solve that problem. Before we explore solutions, however, it is important to reiterate the facts: our extractive and linear economic model is destroying nature and current regulatory frameworks have not been able to reverse this destruction and degradation of the natural world. If we accept these facts, then we also need to accept that the way we have been attempting to regulate activities in the ocean has not been effective. And this leads to another question: Are the current regulatory mechanisms useless, meaning that we need new ones, or can they work and the problem is only that we have not been using them to their full potential?

Having reached this point, let us now explore potential solutions to the main challenges and impacts on ocean systems. Evidently, this is a complex issue with many different dimensions, from the regulation of each activity—fishing, transport, energy, recreation—to the way different societies and communities use the ocean, to area-based management tools such as marine spatial planning, fishing closures, marine protected areas (MPAs) and other effective area-based conservation measures (OECMs), etc.

Most importantly, we know that to address the challenges of the climate emergency and species extinction crisis, we need to be able to decarbonise the economy and to stop destroying nature. However, it is not enough to identify what we need to do (Duarte et al. 2020); it is critical that we have the capacity to do it at a speed, on a scale and with the effectiveness that is compatible with the challenges we are facing.

Marine Protected Areas (MPAs) are one of the most effective tools to protect what is left of the ocean's natural world and, equally importantly, to restore the ocean blue natural capital to pre-industrial levels, so that a socially resilient and economically healthy society is possible. They are also a key complement to conventional fisheries management, as they contribute to increasing fish stocks and to mitigating climate change by protecting marine carbon stocks (Sala et al. 2021). Without nature there will be no future for our societies.

However, in spite of over 30 years of efforts to implement MPAs worldwide, thus far we have only been able to protect less than 8% of the ocean with these legal instruments, with less than 3% of that area excluding extractive activities such as fishing (The Marine Protection Atlas 2022). Moreover, a large percentage of the global MPAs are not effective, i.e. they are not delivering the benefits for which they were created in the first place, and many of them allow

[1] For a complete overview of the existential challenges see: Oceano Azul Foundation (2021).

fishing and other extractive and destructive activities inside their borders. This has two interrelated consequences: on one hand, nature continues to be degraded and recovery to be compromised, even inside many MPAs; on the other hand, society thinks that progress is being made due to the recent race to scale up marine protection and country's announcements around these protections, creating a false sense of success (Sala et al. 2018).

One of the main problems with the way countries and the international community have been using MPAs is the historical lack of a common approach on definitions, criteria and standards for MPAs. Let us now consider these aspects which are critical to the future success of ocean conservation.

MPAs are defined by the International Union for the Conservation of Nature (IUCN) as: "A clearly defined geographical space, recognised, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Day et al. 2019). This means that, for an area to be considered an MPA, there are a set of conditions that need to be met (all of them) so that the expected benefits of protection can be achieved. The long-term conservation of nature needs to be the main objective, which excludes other areas such as fishing closures and other fisheries management areas, military areas, wind farms, aquaculture sites, etc., that may lead to some conservation benefits but are not designated for the purpose of protecting nature. Also, MPAs need to be permanent and not be vertically zoned. They need to be managed by dedicated teams with enough resources to guarantee their surveillance and monitoring. The clearly defined geographical space requires MPAs to be placed in suitable areas for nature conservation but also guaranteeing that they are sufficiently large to achieve the defined objectives. Lastly, they need to provide conservation outcomes that meet or exceed their conservation objectives and goals (IUCN 2018).

A critical aspect of MPA effectiveness is the level of protection. Often, the number and types of activities allowed inside an MPA are not compatible with the above definition and/or their impacts do not allow the MPA to achieve its goals. Moreover, there is often a mismatch between the stated conservation goals and the regulations of the MPA (Costa et al. 2016).

Thus, we have an instrument that works (see below) and can provide the necessary tools to protect and recover nature and deliver economic and social benefits to society, but that instrument has not been used efficiently. Let us now explore what we mean by efficient and effective marine protected areas and how worldwide use of these can be increased in order to provide the solutions for ocean sustainability that are urgently needed.

4 Effectiveness of Marine Protected Areas

Marine protected areas are area-based ocean management tools aimed at protecting and recovering nature. For these tools to be effective they must be designed and managed taking into account the way marine ecosystems function and how they respond to pressures and also how they will respond to the conservation measures to be put in place.

There is often a lack of understanding of the basic ecological and biological characteristics of marine life that need to be taken into consideration when designing MPAs. Since these areas should aim to protect or recover ecosystems as a whole (as even when specific species or habitats are the target, they do not live in isolation), it is critical to consider some key functional aspects in the design and management of MPAs. For example, most marine organisms have a dual life cycle with a pelagic (living in the water column) larval phase and a pelagic or benthic (living associated with the bottom) adult phase. This means that, for example, a species may depend on the dispersal environment where its larvae live, that larvae may associate with floating algae or objects until recruitment takes place, the species may recruit to coastal areas and estuarine habitats such as seagrass beds, spend some variable time there growing as a juvenile, migrate to deeper rocky habitats as an adult and move to specific breeding grounds when it is time for reproduction. In this

single example, a conservation strategy designed to effectively protect and recover the populations of such a species needs to focus attention on all those habitats and areas. Additionally, the life cycles of marine species are variable and different environments are dominated by different strategies, such as those of coastal systems, the open ocean or the deep sea.

Also, dispersal distances vary greatly between groups of species (from a few metres in some algae to hundreds of kilometres in some fish and invertebrates) and different species may disperse during the larval phase, adult phase or both. For example, spiny lobsters travel more than 100 km as both adults and larvae, but red coral do not move as adults and their larvae have very short dispersal distances. Some fish can travel 100 km as both adults and larvae while others disperse as larvae but as adults they remain within the same area for their entire life. This means that the larval and adult movements of marine animals and plants require the size of MPAs to be large, i.e. tens of hundreds or tens of thousands of square kilometres, to allow self-replenishment and connectivity with other protected populations of each species. Few existing MPAs are this large (in spite of current designations of very large MPAs), which means that few MPAs are self-sustaining and need to be considered in the context of national and regional networks of MPAs (Gaines et al. 2010).

MPA networks may be defined as "A system of individual marine protected areas operating cooperatively and synergistically, at various spatial scales, and with a range of protection levels, in order to fulfil ecological aims more effectively and comprehensively than individual sites could acting alone. The system will also display social and economic benefits, though the latter may only become fully developed over long time frames as ecosystems recover" (IUCN World Commission on Protected Areas (IUCN-WCPA) 2008, p. 11).

The concept of networks of MPAs is not new but there are very few global examples of effective and ecologically sound networks of MPAs. One of these is the California Marine Protected Area Network (California State MPAs 2022), comprising over 120 science-based protected areas that were defined following an inclusive stakeholder engagement process.

Besides a large size and/or ecologically connected and representative networks of MPAs, there are additional ecological and biological aspects that are important to consider. Some fish species are known to aggregate during breeding in specific areas and fishers know this all too well and target those areas for increased and fast revenues. However, fish aggregations are critical habitats that must be protected since they are the support for the replenishment of populations. Some particular areas may have a disproportionate role as breeding and nursery sites, for example, estuaries or seagrass beds. This means that, in addition to size, the positioning of MPAs is a key feature for effectiveness and, moreover, to fully derive the benefits of protection, MPAs need to be integrated in ecologically representative and connected networks and work together with other management approaches in the wider seascape.

Another important variable for management considerations is the size of fish and its impact on population dynamics. In several species, female reproductive output increases exponentially with fish size. A well-established effect of MPAs is that fish grow larger inside their borders and these fish produce exponentially more young that are also of higher quality (i.e. they have a better survival rate). For instance, in the case of the European seabass, a female of 40 cm produces 250,000 young, in comparison with 1.3 million for 60 cm and 3.3 million for 80 cm (Erguden and Turan 2005). Allowing large females to grow and breed is therefore invaluable in sustaining healthy fish populations and healthy fisheries. Yet, this is often counterintuitive since there is the perception that catching larger fish is more sustainable.

Adopting a science-based approach to the implementation of MPAs, and incorporating the biological and ecological aspects mentioned above, pays off as a strategy since well designed, regulated, implemented and managed MPAs which are fully protected provide benefits that science has named "the reserve effect". In global analysis of marine reserves (those MPAs which are fully protected), biomass increases of more

than 400% on average have been described (Lester et al. 2009). Moreover, since fish do not stay inside these reserves, increased catches and recruitment may occur in the nearby areas (Russ et al. 2004). In some instances, fishers quickly understand the value of these fully protected areas and start increasing their fishing effort right on the limits of these marine reserves, in what has been termed "fishing the line" (Kellner et al. 2007). On the other hand, weakly protected MPAs do not differ from fished areas (Zupan et al. 2018) and, as such, are not able to provide benefits or protect nature.

Time of establishment is also an important consideration to assess the effectiveness of MPAs. In fact, there is always a gap between setting the rules and finding the right conditions to start changing human uses in the ocean, and the biological and ecological responses of marine systems. Indirect effects may occur through cascading trophic interactions and take longer than direct effects on target commercial species. In many cases, the initial effects of protection can occur rather quickly, within 5 years of establishment, namely for exploited commercial species (Babcock et al. 2010). However, this response is species and system dependent and deep-sea species, for instance, may take much longer to recover from impacts. Species grow and mature at different rates and, hence, the benefits of MPAs will be displayed with different time scales. Some fast-growing species may achieve reproductive age at 6 months to a year (for instance squid or octopus), while others may take years (e.g. seabreams 2–4 years, some tuna species 3 years, dusky-groupers 5–12 years and white sharks 9 years). Deep-water species such as the orange roughy fish, may mature at around 30 years and may live up to 150 years. For others, such as deep-water corals, these variables are measured in centuries (Roark et al. 2009).

Although the science on the benefits of marine protection is clear, and there are currently 16,675 MPAs, only 6.1% of ocean within national jurisdictions is in implemented and fully/highly protected areas and the respective percentage in the high seas is a mere 0.8% (The Marine Protection Atlas 2022). Moreover, 94% of MPAs allow fishing, which prevents them from providing the full benefits of protection as they are not able to protect all their biodiversity components (Costello and Ballantine 2015).

With strong scientific support guiding decisions, clear knowledge of human impacts on the marine environment, and an effective and transformative tool for change (MPAs), what can we do better (and faster) to implement a global network to protect 30% of the global ocean in fully and highly protected areas by 2030 (this is the current target recently approved in the context of the new Post-2020 Global Biodiversity Framework of the Convention on Biological Diversity)?

5 What Can Be Done to Increase the Speed of Establishment, Extent of Protection and Success of Implementation of Marine Protected Areas?

A global network of scientists, practitioners, managers, and representatives of civil society and governmental organisations recently published the MPA Guide (Grorud-Colvert et al. 2021). This is the most complete study summarising the scientific information needed to understand how to plan, implement, evaluate, and monitor successful MPAs.

The MPA Guide outlines a recommended procedural framework to be followed as a critical step towards ensuring conservation efforts meet global, regional and national objectives and goals. This is a fundamental charter not only to assess what we are protecting and evaluate the effectiveness of that protection, but mostly to guide decision-making around successfully establishing these area-based management tools.

First and most importantly, it is necessary to accept that the establishment of an MPA must be a science-based process driven by governments and communities (allowing for different models of governance) and that it implies structured and consequential stakeholder engagement procedures.

Science guides the location, size, shape and spacing of MPAs in ecologically coherent, representative, and connected networks. This involves compilation and summarising of existing scientific information about natural values and human uses, and model scenarios for current and future climate realities, finding potential areas of conservation interest that encompass, for instance, intact and pristine ecosystems, species and habitats of conservation interest (e.g. IUCN red list, FAO vulnerable marine ecosystems), areas with restoration potential, climate refuges and corridors, migratory pathways, habitats and species representative of the biogeographic area of interest, populations of species of commercial value, trade-offs and cost-benefit analysis for fishing and other uses, etc.

For each MPA and for the network of MPAs under consideration, principles, objectives and design criteria should be proposed and agreed upon with stakeholders as a basis for systematic conservation planning approaches applied to the whole territorial seas and EEZ of countries (Margules and Pressey 2000). These should be based on a shared common vision for the ocean of that country and/or region, consolidated in legal instruments or frameworks. These approaches are effective only when there is sufficient buy-in, awareness and engagement of whole communities and interested parties. Public participation and effective engagement of not only the different levels of government but also civil society and economic actors, is therefore a key component of any successful process. Examples of principles relevant for the topic are science-based decisions, the precautionary principle, adaptive management, the ecosystem-based approach, transparency and information, stakeholder engagement, integrity of ecosystems.

Objectives (preferably quantitative) should include both natural and social dimensions, such as protecting vulnerable marine ecosystems, protecting relevant habitats and species, protecting pristine areas, including unique areas, species or habitats, integrating climate refuges, protecting essential fish habitats, recovering species and ecosystems, maintaining geographic diversity, maximising conservation outcomes and minimising socio-economic costs, respecting and integrating the rights of coastal communities and Indigenous peoples, etc.

Design criteria are important to frame the size, shape and spacing of MPAs within the network. They may include connectivity, representativity, replication, resilience, etc.

Importantly, an understanding of current uses, rights and social considerations is a critical aspect not only when defining the MPA objectives and processes for its designation, but mostly to guarantee that it is implemented respecting those rights and engaging the relevant interest groups.

One of the main barriers to successful MPA designation and implementation are economic considerations, namely in relation to fisheries but also to wider benefits to the community. Economic analysis and considerations including compensation mechanisms for affected activities, reallocation of effort, derived direct and indirect economic benefits and allocation of those benefits, and sustainable finance are also key aspects for MPA success. A variety of tools are available to finance MPA implementation, from more traditional tools such as fees, fines, and taxes, to new mechanisms associated with trust funds, debt-for-nature swaps, blue bonds and carbon markets. In order for these mechanisms to be successful, legal frameworks are essential. There is not a one-size-fits-all solution, and these tools need to be adapted to the socio-ecological realities of the area, placement of the MPA (e.g. coastal vs offshore), intensity of uses, level of impacts, etc.

For an MPA or network of MPAs to be successfully implemented, a set of governance conditions outlined in the MPA Guide should also be taken in consideration. Staffing and funding have been shown to be some of the main drivers of implementation success (Gill et al. 2017). Compliance, enforcement, monitoring, adaptive management, integration of culture and traditions, social justice and empowerment and effective conflict-resolution mechanisms are also examples of relevant aspects to include in implementation strategies that should be designed upfront and committed with all stakeholders engaged.

For an MPA to be effective it needs to be implemented and actively managed (MPA Guide). This means that areas which are only committed and/or designated (even if legal instruments have been approved) are not able to provide a response to the established objectives of MPAs. These are critical first steps, but only once rules exist can enforcement of those rules be assured, and a high level of compliance be attained; a true MPA is one that exists in reality (everything else is what has been termed a "paper park").

In the light of the current climate and biodiversity challenges and the urgent need to reverse the destruction of marine ecosystems and increase climate resilience through nature-based solutions, we also know that the protection levels that need to be implemented in the global network of MPAs are directly linked to the expected results of those levels. Only fully or highly protected MPAs are able to reconstruct a healthy ocean, with all the benefits associated with a thriving nature. Therefore, it is particularly important to understand that several activities are not compatible with nature conservation and, hence, are not compatible with MPAs. Examples include oil and gas exploitation, seabed mining, dredging and dumping, industrial fisheries, large scale and intensive aquaculture, heavy infrastructures, and intensive unsustainable extractive and non-extractive uses.

The framework outlined here follows the best scientific practices and information and constitutes a roadmap for change. However, we will only be able to reverse the current degradation by speeding up and scaling up the implementation of MPAs through structured processes applied at regional or country levels. One example of such an approach is the Blue Azores program (Blue Azores 2022), a collaboration between the Government of the Azores (Portugal), the Oceano Azul Foundation and the Waitt Institute, which engages scientists, fishers, ocean users, non-governmental organisations, and the wider society, to protect, promote and value the blue natural capital of the roughly one million square kilometres of Azorean ocean, protecting 30% of the EEZ and fully protecting 15% in a connected and ecologically coherent network of MPAs. This is a 6-year program that can bring transformative change by protecting what is left of these amazing coastal, open ocean and deep sea ecosystems in a socially integrated and fair way and providing the economic benefits to the region of this added protection. These approaches may be adopted by others, replicating these successes and helping to achieve the global targets in a timely and effective manner.

6 What Does a Sustainable Future Look Like and What Is the Role of Marine Protected Areas in That Future?

If we follow the science (e.g. the IPCC and IPBES reports), we know that we have a problem—we are destroying the ocean and the current regulatory mechanisms are not working. We also know that there are solutions to that problem, but those solutions need to be applied in an effective manner. MPAs are tools to achieve ocean sustainability but only if they are implemented following the framework described here.

More broadly, MPAs need to be placed in a wider context of a 100% managed ocean, where these nature conservation tools are the "banks" of natural capital. With more nature, there will be a better qualified economy, for instance more sustainable and nature-centred tourism, and more sustainable small-scale fisheries which will benefit from the biomass increases exported from MPAs and from enhanced fisheries management rules. Also, MPAs imply that destructive activities are excluded and therefore countries will need to address the trade-offs of continuing to support those activities. Industrial large-scale fisheries are an example of such a trade-off. By protecting nature, MPAs are also the powerhouses for biotechnological applications of the bioeconomy. It is clear today that future sustainable materials, foods, medicines, etc. will come from the ocean and that if we continue to lose biodiversity value at the species, genetic and ecosystem levels, we will continue to degrade a critical natural economic asset for the future.

The global community has now committed to protecting at least 30% of the ocean by 2030. MPAs are a proven effective tool in preserving and restoring biodiversity and recovering biomass in the marine environment, but also in helping address climate change by increasing carbon capture and in increasing social and economic value. The Kunming-Montreal Global Biodiversity Framework recently approved at the Conference of the Parties of the United Nations Convention on Biological Diversity, included the 30 by 30 goal in the agreement. It is critical that beyond area targets, such as the 30% protection, the quality of that protection (fully or highly protected MPAs) and of the implementation mechanisms to be established, is also part of the implementation strategies. The European Union has adopted this target under the Biodiversity 2030 Strategy (European Comission 2030), aiming to protect 30% of land and sea by 2030. Of this, at least 10% should be strict protection, although the definition of this is yet to be agreed. We are however very far from these targets and, in particular, very far from adopting an integrated and effective framework, such as that presented in this text. For example, more than half of the European MPAs have not been implemented, and 50% of the areas are less than 30 km^2 (the majority of these being less than 5 km^2), thus being limited in representativeness and effectiveness. Recent assessments (European Court of Auditors Special Report 2020; European Environment Agency Report 2020) demonstrate that EU policies have not restored the seas to a good environmental status, fishing in Europe has not yet reached sustainable levels, and marine biodiversity remains under threat in Europe's seas.

We need therefore to do more, faster and differently. MPAs are part of a broader new blue framework based on an economic model to achieve 100% sustainable ocean management and departing from an unsustainable, linear and extractive economy to a resilient, nature-based economy that supports thriving societies and a healthy planet. MPAs can deliver significant benefits and help reconcile human development with nature. To do so, the right scientific, legal and procedural frameworks need to be adopted.

7 Conclusion

The current environmental existential challenges of the climate emergency and species extinction crisis demand a response that, without delay, applies the right fixes that go to the root of the problems. And the root of these problems is our unsustainable relationship with nature where our current economic systems require nature to be destroyed in order for societies to have economic development and derive human wellbeing. This is an unsustainable model that has no future and the current discussions on policies and targets to be achieved in the next couple of decades are seeking to address this problem.

In the ocean, the wide and deep degradation of marine ecosystems, and the inefficient regulatory frameworks currently in place, require a faster, wider and more efficient set of management and governance mechanisms to be established. Marine protected areas have been shown to be a very effective tool in protecting and recovering nature and providing social and economic resilience and wealth to societies, but only when they are established by structured and effective programmes following the best available scientific guidelines and standards.

The updated standards compiled and addressed in the MPA Guide, complementing the existing framework of the International Union for the Conservation of Nature (IUCN), are a critical tool for managers, practitioners and decision-makers and should be widely used in guiding conservation efforts at national, regional and international levels.

Whatever we do in the next decade to address these challenges will have a profound effect on the state of the planet we will pass on to future generations. The time to act is now but we know there are different possible futures ahead of us. Business as usual will result in a continuously degraded ocean with fewer economic revenues and larger social impacts. A system maintaining and perpetuating the current misery of a degraded ocean due to a lack of capacity to implement the needed measures will not be able to reverse degradation or allow restoration. The way forward,

then, has to be a vision of a healthy ocean with thriving nature, where well designated, located, managed and implemented MPAs inserted in a wider 100% managed ocean are the basis for a new sustainable blue economy, with social sustainability at its core and including fair sharing of benefits and effective governance systems that respect the rights of communities.

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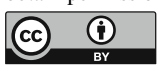

Part III

Law, Policy and Ecological Sustainability

Renewable Energies, Sustainability and Law

Suzana Tavares da Silva and António Gomes Martins

Abstract

Renewable energies are considered by many the driving force of the economy of our future society. However, there is a difference between reality and the perception of the situation by governments, economic players, and communities. We need more transparency, simplification, and data communication skills towards a committed involvement of all stakeholders.

Geopolitics and technological development are two drivers of a common issue. They are, though, not necessarily aligned with energy and climate political goals. Globally, we find different problems and solutions in the two hemispheres. In the EU, problems and solutions are common throughout the Union, but some political hesitation prevails.

We need innovative solutions for a smooth transition to a market organization that includes renewables and accurate risk management in investment programmes.

Keywords

Renewable energies · Environmental sustainability · Social sustainability · Economic sustainability · Political sustainability · Energy transition

1 Introduction

Many now believe that renewable energies will be the driving force of the economies of the future. They are likely to replace fossil fuels in the world's economy. This, to put it simply, is what the *energy transition* is all about. Some other popular expressions in current public policies, such as "climate-neutral economy", "circular economy",[1] "decarbonisation" and "sustainable development", address different perspectives of this "desirable reality". But is it that simple?

[1] The circular economy is a "virtuous idea" for interrupting the classical one-way model of production, where goods are manufactured from raw materials, sold, used and discarded as waste. It started with the concept of recirculation of resources, firstly discussed in the Stockholm Conference (1972) and then formulated at the 2012 World Economic Forum. In 2015, the European Commission adopted its first circular economy action plan, COM(2015) 614, which was replaced, in 2020, by the new Circular Economy Action Plan, COM(2020) 98 final. The circular economy action plan is now one of the key building blocks of the European Green Deal, along with clean energy.

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In 2015, when the United Nations agreed to *"change the world for better"*[2] by 2030, it was decided that the future would rely on *"affordable and clean energy"*.[3] The European Union took the same stance when it approved the *"clean energy for all Europeans package"*.[4] The measures approved by the European Institutions take into account five dimensions of energy union—security, solidarity, and trust in energy supply; a fully integrated energy market; energy efficiency improvements; climate action through decarbonisation of the economy; research, innovation, and competitiveness.

Hence, any study of renewable energies and their regulation, whether it is from a global or European perspective or simply from the perspective of a single State, will always need to be conducted within the scope of this legal and political framework.

Our reflections will focus on the difficulties faced by regulators. Since the energy transition will require the involvement of all, governments will need to work with different regulatory instruments and different approaches. Whether this means implementing taxes or providing funding, establishing bans or issuing advice, all measures will require a high level of trust and transparency, with clear and simple rules and significant public spending on state aid.

Renewable energies are now playing a key role in electricity production, but it is crucial that we increase their use in industry, transportation and cities, in order to meet the climate change challenge in developed countries. However, many unanswered questions still remain, particularly how a broad sustainable solution can be designed that simultaneously provides clean and affordable energy in sufficient quantity to meet increasing demand, employment stability in a context of permanent technological change, legitimate expectations for investors with no sunk costs for consumers and taxpayers, and transparent state procedures on managing these policies with powerful international players.

Our last key reflection will consider the role the law can play in this unstable equation.

2 Energy Transition and Truth

It is essential that we provide transparent and clear information if we genuinely want everyone to be involved in achieving this generational and global task. However, this is perhaps the first difficulty to overcome. It has never been so easy to obtain and disseminate data, using all-new communication tools (including social networks), but it has also never been so difficult to obtain reliable and accurate information.

Even in this technological and ultra-regulated domain, the level of opacity is high. We need people to be aware of energy prices and to encourage them to work together to improve efficiency, but we do not provide them with clear and precise information on energy bills. We need them to be part of an active energy community, but it is difficult for them to obtain reliable information on the economic and financial benefits. We need them to reduce their carbon footprint and invest in green energy technology, but they receive so many different figures and information on the capacity of renewables and their

[2] This "change" means, for the UN and its Sustainable Development Goals, a global effort to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity; for the OECD countries, a transition to a climate-neutral economy, to clean energy in cities and to a circular economy; and for the European Union, an improvement in the well-being of citizens and future generations. At all these levels and policy programmes, the "change" relies on the use of renewable energy.

[3] The UN 7th Goal "ensure affordable, reliable, sustainable and modern energy for all" aims to increase the share of renewables in energy supply, improve energy efficiency and provide access to good quality energy services, which means investing in solar, wind and thermal power, improving energy productivity, expanding infrastructure and upgrading technology.

[4] This EU 2016 package includes eight new laws *i)* on the energy performance of buildings (Directive 2018/844), *ii)* on renewable energy (Directive 2018/2001), *iii)* on energy efficiency (Directive 2018/2002), *iv)* on the governance of the Energy Union and Climate Action (Regulation 2018/1999), *v)* on internal electricity market design (Regulation 2019/943), *vi)* on risk-preparedness in the electricity sector (Regulation 2019/941), *vii)* on the European Union Agency for the Cooperation of Energy Regulators (Regulation 2019/942); *viii)* on common rules for the internal market for electricity (Directive 2019/944).

externalities and sustainability, that they cannot be sure they are really making the right choices.

At times, the curse of the post-truth era also seems to be present here.[5] Companies produce information to sell their products and services and increase their profits, banks produce information to sell financial services and increase their portfolio, national and local governments produce information to be re-elected. As is typical in the post-truth era, none of these discourses is false; they all are based on facts, but they are also brand-centred narratives and, in some way, marketing-oriented.

So, the first challenge to be met in the energy transition is to increase energy literacy. We need independent mediators to collect and transmit reliable, accurate and organised information on energy end-use and on renewable energy sources. Only informed citizens can be a part of this journey, and we need to engage all of them in this millennium goal.

Increasing digitalisation in the energy sector could be a helpful tool. Replacing human choice with automatic "decisions" will improve energy efficiency and result in an optimised system with integration of renewable sources (by enabling networks to better match energy demand to times when the sun is shining, and the wind is blowing). However, this area also carries some risk with it, and must, therefore, be implemented with strict regulation on privacy, cybersecurity and digital resilience (IEA 2017).

Innovation is also key to success. Renewable energy sources that have recently been regarded as attractive investments, such as solar and wind power, have benefited from constant innovation aimed at increasing efficiency and power output. Even more classical energy sources, such as hydropower (including tidal power), geothermal and biomass have seen incremental technological progress through innovation. The main limitation of solar and wind energy is their inherent low density. They both require large areas of energy collectors (PV panels, mirrors or wind generator blades) for significant power output. Large areas of land are required for power plants, giving rise to difficulties in terms of land use and land use change, which require innovative approaches to avoid detrimental impacts on the environment. The last solution for energy supply, nuclear fusion technology, is still being developed and heavy investment is required for research into innovative materials such as superconductors to create powerful magnetic fields to contain the fusion plasma.

The energy transition is not exactly a public policy, but more of a policy instrument to tackle climate change and, ultimately, to achieve the desired new developing global economic model and new sustainable lifestyle for world citizens. There is a long way to go, but it is imperative that we step up the pace. Different approaches are at play, on the supply and demand sides, among them public policy tools (from classical command and control[6] to recent market-based mechanisms)[7], nudging[8] (as a powerful

[5] "Post-truth" was "the word of the year" in 2016 and the Oxford English Dictionary defines it as an adjective "relating to or denoting circumstances in which facts are less influential in shaping public opinion than appeals to emotion and belief". It is generally applied to politics and its language, as well as to newspapers and media. However, it also affects science domains. Different authors, from different social science domains, say that people need a full range of literacies or meta-literacy to navigate in a post-truth world (Fuller 2018; Bartlett 2020). This is also true for the energy transition, since it is essential that people understand rather than believe in good or bad theories about the increasing use of renewables.

[6] Among these *command-and-control* measures we can highlight: *i)* the European mandatory share of renewable energy in gross final energy consumption, in the heating and cooling sector, and in the transport sector (European Union 2018); *ii)* the European mandatory limits of air pollutants emissions (European Union 2019).

[7] Market-based mechanisms give firms the flexibility to adapt to mandatory measures (for example, the green certificates market). When these market-based mechanisms are in place, firms can choose to reduce their emissions, or to incorporate renewable generation in their process, or to pay for/buy it instead. When a firm pays to pollute and pays to use fossil fuels, it is financing the "change" of the more efficient firms (those which can more easily and cheaply update and use better technologies) at low capital costs, at least in an earlier stage of the process. Market-based mechanisms are also popular as energy efficiency tools, such as white certificate markets or the provision of electricity saving services.

[8] Nudging means organising the context where behavioural decisions are taken (Thaler and Sunstein

instrument to change behaviours) and (future) solutions that are being tailored along the way.

Much of what is needed to optimise energy use will only be possible with new technologies, particularly robotisation, artificial intelligence and the Internet of Things, which will substitute inefficient human behaviours.

On the supply side, we need generation to be efficient, cost-effective, and reliable, to ensure security of supply. This means innovation not only in new renewable generation projects but also in energy services.

In the European clean energy package, storage plays a decisive role in providing flexible solutions in electricity services (European Commission 2020b). It is expected to have a great impact on electricity markets, and new and important players will emerge, for example active citizen communities.

To put all of these innovative solutions into action, we need reliable information, financial solutions, and confidence, mainly in the regulators. Financing options exist in appropriate numbers, at global,[9] regional,[10] and national[11] public levels, and among private companies that are engaged in this shift to a low carbon and sustainable growth development model.

Confidence in governments and economic public regulators is also a key for success—some of the main arbitral decisions on international investor-state disputes demonstrate that this is not a simple task. Not so long ago, these dispute resolution bodies (ICSID, UNCTAD, ICC) were often called on to solve conflicts arising from fossil fuel exploitation contracts entered into between developing countries and large corporate groups owned by investors from developed countries. More recently, however, investors from all over the world have been bringing claims against developed countries based on frustration of legitimate expectations on financing renewables programmes.[12] This essentially means that the risks are high in these financial incentive programmes and some aspects should be strictly and clearly regulated, such as risk allocation or consequences of unexpected changes.

Having good regulatory instruments is also important. Many questions were raised in a recent interpretation on the application of the Energy Charter Treaty (ECT) with regard to investment in renewables and its harmonisation with the European state aid law (Baetens 2019).[13] A better approach might be to have normative guidance under a structural solution (which could also come from an ECT revision) reconciling energy transition and investment objectives, and which explicitly addressed issues such as investors' due diligence obligations, fair and unfair change of regulations, or the disproportionate impact of measures on investors. Without this, confidence on both sides is low, which leads to high capital costs and, ultimately, to an inefficient lose-lose situation. This is, essentially, more a gap in regulation than an issue of absence of good faith.

Regulators are aware of these difficulties, but there is no simple answer. In fact, the solution is dependent on international legal instruments and political consensus, which is difficult to obtain in this field, especially when hard law on sensitive

2021). To promote the energy transition, plenty of measures have been successfully implemented, such as energy labels, carbon footprint disclosure on energy bills, software apps for energy management offered by electricity utilities, smart appliances, the provision of energy savings services.

[9] The World Bank Group provides financing solutions and specialised support on environmental and social policies in developing countries, mainly based on renewable generation projects aimed at connecting people to electricity.

[10] Renewables are also an important financing topic in NextGenerationEU (NGEU), the largest stimulus package ever financed in Europe.

[11] Today, public funding programmes for renewables are common tools in national budgets, as IEA points out. Besides Europe, the US's investment in clean energy, RD&D by 2025, China's National Major Science and Technology Projects programme, and Japan's Environment Innovation Strategy are also important financing programmes.

[12] Spain is currently the most affected country. In these cases, authors and the courts had different visions, some considering that the issue at stake was merely a 'regulatory change' and others pointing out that Spain violated the Fair and Equal Treatment standard when it changed remuneration rules that affected ongoing projects (Noilhac 2020).

[13] The problem is also present in the WTO disputes, as will be seen below.

economic issues needs to be approved. Here, we are facing not just a gap in regulation but perhaps a *regulatory dilemma*.

Previous experience has already shown that the *feed-in-tariff* is the most effective incentive regime (Mendonça et al. 2010), but also the least accurate in terms of efficiency, because its effectiveness is linked to long- or medium-term purchase agreements, and this is not a flexible solution.[14] The new EU incentive regime (European Commission 2013), based on flexible *feed-in-premium* payments that require producers to send their electricity into markets and link public payment amounts to market prices, is a more flexible solution. However, it is a less attractive economic tool and not necessarily more efficient, because it depends on coupling incentives with caps (or even floors) that must be strictly calculated on a cost analysis basis.

Some authors claim that for future solutions to be simultaneously effective and efficient they must rely on *new energy markets* (Kopsakangas-Savolainen and Svento 2012). Although there is some experience in this area (mainly in real time-pricing), there have so far been no consistent advances.

Meanwhile, time is passing, and regulators must act because the planet is waiting and is demonstrating that it cannot continue to wait for much longer.

Even in a strict and limited economic analysis, it cannot be stated in all certainty that the burden we are passing on to future generations by adopting inefficient regulatory solutions is heavier than maintaining the status quo. Extreme climate events are becoming increasingly frequent and devastating for human lives and economic assets.

[14] In Europe, only Germany adopted a balanced *feed-in-tariff* model, the public payments of which decreased over time.

3 Energy Transition and "Sustainabilities"

The main policy drive of the energy transition is *sustainability*, so the whole normative solution must contribute to this goal. Sustainability is easier to understand than to put in practice; the desired outcome is clear—a balanced model of economic growth and a fair society—, but there is much darkness and light to be found along the way.

3.1 Environmental Sustainability

Scientists and politicians are unanimous in accepting the crucial role that renewables should play in the future, not only in terms of decarbonising the electric power sector but also in other energy sectors such as fuel for transportation.

However, any reflection on renewable energy and its environmental sustainability must also consider its "dark side", that is to say, the negative impacts it has on the environment (Kramarz et al. 2021).

Since the early days of the deployment of renewable energy technologies, scientists have been warning that this cannot be considered unconditional "clean energy", particularly with the advent of solar PV plants. At that time, the discussion only centred on the negative impacts from the most developed and widespread renewable technologies, such as the impact on ecosystems and on wildlife caused by giant hydroelectric power plants; the death of birds and bats and impacts on landscapes from wind farms; soil erosion and use of good land for solar power plants; food scarcity and forest depletion linked to bioenergy production (Strapasson et al. 2020); and toxic gases resulting from the increase in geothermal energy use.

Today, concerns about the sustainability of renewable energy are more complex and should be carefully addressed. One example is global governance of supply chains for copper, cobalt, cadmium, lithium, and other rare earth elements.

Once again, there is insufficient information on environmental impacts resulting from the shift in mining and industrial activities, and there is little comparative analysis between renewable and fossil fuel energies based on their life cycle.

Environment and climate protection cannot simply be reduced to a decarbonisation policy. Although renewable energy production tends to be more decentralised compared to conventional electricity generation plants using fossil fuels, the fact is that renewable energy facilities are intensive users of raw materials (Pitron 2020). Furthermore, to produce wind generators or photovoltaic cells, the industry requires heavy processing and emits significant amounts of GHGs (Bonou et al. 2016; Srinivasan and Kottam 2018).

To tackle these threats, many international regulators are using soft law measures, mainly inspired by the UN Guiding Principles of Business and Human Rights, for example the EU Conflict Minerals Regulation (European Union 2017) and the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals. The Extractive Industries Transparency Initiative (EITI)[15] and its standards are also expected to play a greater role. However, as we will see, this soft regulation may not be enough.

It seems obvious by now that a fair energy transition (an ethical renewable energy transition[16]) needs a global responsible mining pact. Only this approach will prevent a new global tragedy of the commons and another "resource curse" economy affecting new countries. Yet, we can perhaps no longer wait for a miracle in international politics; the planet cannot wait, so we must move forward, but, at least, consciously.

It is also not clear at this time whether there will be some kind of global technical regulation (even based on soft guidance) that could help nation-states assess their best options on energy supply. Relying on renewable energy means relying on endogenous natural energy sources and it is desirable for countries to cooperate, coupling markets and developing transnational projects or collaborative solutions[17] that could contribute to better land use and optimisation of resources (for example, the sun in the desert or the wind in the inhabited mountains). Still, this goal will be hard to achieve, as it requires a political context and a level of confidence in international economic relations that is far from the present reality.

Lastly, we have seen the polluter pays principle and environmental taxation entering and leaving these "renewables equations" many times. It is time to ask if polluters have a role to play in supporting the energy transition. If we look at the EU experience, it appears that this is not a particularly useful tool or means of addressing the energy transition, in particular with regard to its funding.

In effect, the EU Emissions Trading System,[18] as well as the polluter pays principle (European Court of Auditors 2021), which are well-known tools created to address environmental change, have recently shown that regulation mechanisms based on price are difficult to implement[19] and sometimes difficult (if not impossible) to turn into a virtuous tool, even in more homogeneous societies (Jacobsen et al. 2003; Skygebjerg et al. 2020). So, we may perhaps say that one lesson learned on this matter is that pollution cannot

[15] A voluntary corporate social responsibility (CSR) programme to promote the open and accountable management of oil, gas, and mineral resources.

[16] It is important to note that the energy transition may require different tools and policies because it will not affect all countries in the same way (Kumar et al. 2021).

[17] This goal is at the heart of the European Energy Union, but even in this "hard regulated" region, we are far from succeeding, judging by the low number of joint support schemes and joint projects developed by Member-States (European Commission 2020a).

[18] On 14 July 2021, the European Commission adopted legislative proposals (included in the Fit for 55 legislative proposals) setting out how it intends to achieve climate neutrality in the EU by 2050, including the intermediate target of a net reduction of at least 55% in greenhouse gas emissions by 2030.

[19] Environmental taxes and pricing mechanisms on the environment and nature are relevant tools to send the right signal, but not to impose a behaviour change. Raising prices can be a virtuous nudge if we have an equivalent alternative product service or behaviour; if not, we will simply increase public funds by increasing inequality (because the additional cost will not reach everyone in the same way).

finance the energy transition, nor can it help with a fair climate transition, even in most developed countries.

3.2 Social Sustainability

Governments and international institutions often present the energy and climate transition as an opportunity to create more qualified jobs with higher wages, mainly on renewable energy projects.[20] The transition is expected to produce some immediate social benefits, which may be direct (reductions in pollution and lower prices for goods and services) or indirect (rise in the standard of living and the entitlement age in developing countries). On the other hand, the energy transition will represent an economic burden for present and future generations, with rising electricity bills and taxes as well. Moreover, this huge economic and financial effort for society will channel scarce public funds towards investments in this sector, leaving other sectors behind. This is also a risky decision.

Another social dimension of this sustainable change in the economic development model is that everyone (alone or as part of a local energy community) will be able to actively generate their own 'clean energy', mainly electricity, and take immediate advantage of it.

However, from a social perspective, the benefits may not all be cost-free, and some could even involve some sacrificing of equal economic treatment for those who choose not to actively participate in the process (personally or through a mediator).

In effect, some issues on the social impacts of the energy transition have not yet been resolved. It is not clear whether this new developing energy model will be sufficient to maintain the present level of energy use in the Northern Hemisphere and, at the same time, ensure an equivalent level of energy use for developing countries. There is no easy answer to this question. We must have faith in science and technology experts, who are working hard to combine energy efficiency (a significant decrease in end-use energy) with optimisation of electricity generation and transmission systems, to provide more end energy but with a lower input of primary energy. But will these improvements in science and technology be enough? And are all the new energy options neutral from a social point of view? We do not yet know.

Projects of large renewable energy power plants emerging in developing countries and funded by developed ones[21] are not immune to criticism.[22] Even when they are set up in desert or mountain areas (with less impact on land use and ecosystems), they can affect vulnerable local communities and their ancestral land uses and practices, without giving these communities anything in return.

Optimising energy use and making it socially sustainable does not mean that energy products and services with fewer emissions and lower environmental impacts will be equally available to all across the Globe. It is likely that in the future nations, economic actors, and citizens all over the world will face certain limitations on their energy use when compared with the present so-called western lifestyle. Individual acts[23] and private or public economic projects[24] may all be subject to behavioural and procedural limitations if the rate of climate change requires us to accelerate emissions abatement.

However, it is undeniable that, in a short-term analysis, we can point to plenty of social benefits that may arise from this energy change in all

[20] IRENA estimates that renewables accounted for 11.5 million jobs worldwide in 2019, up from 11 million the previous year (IRENA 2020b).

[21] Besides the world bank funding mechanisms, we can also see IRENA/ADFD Project Facility (IRENA 2019).

[22] This is not new; there are a plenty of examples of the social impacts of dams (Tortajada et al. 2012; Kirchherr and Charles 2016).

[23] Although there seems to be a consensus that combustion vehicles must be banished from city centres, the compatibility of these measures with fundamental rights has recently been challenged.

[24] Limits to the international law principle of permanent sovereignty over natural resources are again relevant issues in renewables projects governance and investments, such as transboundary water management, responsible mining, or land use policies.

latitudes.[25] So, as always happens when balance and proportionality principles are used to legitimate public acts and decisions, the change should be approved as the benefits outweigh the disadvantages. But can we apply this principle in this field, or should the responsibility to protect prevail and ethics push us towards more complex case-by-case decisions?

Social sustainability can also be analysed from a different point of view: the way society is organised to deal with the responsibilities emerging from the energy transition. Local energy communities (both from the consumer and producer perspectives) play an important role in the EU directive on renewable energy. According to this EU law, energy communities can be a way to 'organise' collective energy actions around open and democratic participation and governance for the provision of benefits to the members of the local community (Caramizaru and Uihlein 2020). Although this is a 'good idea', it may not be so easy to implement. In addition to other barriers, we would like to stress the current cultural gap in dealing with community actions in many western countries, as well as the complex social organisation of the South. There is not only a gap in regulatory tools (CEER 2019), or in economic incentives; there is also a skills and cultural competence gap when it comes to joining individual interests together to produce a collective good. The current, predominantly selfish, nature of western communities means that social innovation alone is not enough; cultural innovation is also required to develop skills related to collective actions.

[25] One of the most cited examples is solar electric cooking in rural Africa and Asia (*see* World Bank Clean Stove Initiative), which can bring enormous immediate benefits for the climate and women's health (Pangestu 2020), as well other benefits, such as access to lighting that implies more information and education for many isolated communities. In western countries, restrictions on car travel lead to improvements in air quality in cities and less noise.

3.3 Economic Sustainability

We have already noted that an energy transition to a renewable-based energy model will only be possible if it relies on an integrated circular economy process, which implies including in the equation the whole renewables life cycle, from raw materials mining to facilities discharging. Only then will it be possible to analyse the sustainability of this new energy model from cradle to cradle.[26]

Moreover, any analysis of the sustainability of the energy transition will need to take other economic issues into account. In the case of electricity, for example, which is expected to become the main energy source, it will be necessary to simultaneously manage two systems: the old "one way" system, based on large generation facilities and transmission and distribution networks that carry electricity to consumers, and the new system, based on distributed energy resources, with small-scale production facilities complemented by stationary storage facilities and electric vehicles. Will consumers be able to pay for this "duplicated" system? How can we fairly allocate the corresponding fixed costs?

Another problem relates to energy markets and electricity prices. It appears that market price design is now lagging behind the technological revolution. The mechanism currently used to fix the price for power exchanges is no longer suitable. As the share of renewables grows, the traditional "merit order" (marginal costs of generating units) for setting the price of electricity (the 'energy only' market model) has become outdated. This method adopted an exchange price adjusted to competition between technologies with different variable (high and relevant) costs, and was suitable for generation costs based on commodities prices.

Now, all renewables, regardless of the different technologies they use, have variable costs close to zero. The issue in the future will no longer be merit choices but selection of a method

[26] This "cradle to cradle" principle is the current standard for sustainable development, mainly in the industrial sector (Braungart and McDonough 2002).

that can provide the price signal which will use flexibility management procedures to ensure that load, together with energy storage, will adapt smoothly to the available level of generation so as to guarantee that no rationing (rolling blackouts) occurs. Hence, energy generation prices will probably disappear, and fees for "grid use", and also "capacity pricing", are expected to gain greater relevance over time (Hancher et al. 2015), alongside reward mechanisms for demand-responsive actions by consumers.

This transformation will not affect only the electricity market; it will also have a great impact on the most important energy players. Businesses, especially major energy companies, need to rethink their strategy in a wide range of areas. Their main concerns should be their approach to risk, the way they should adapt their generation and transmission infrastructure, and how they will replace old-fashioned business models.[27]

Many oil and gas companies have also become major players in the renewables field, having realised that "the Change" was a certainty. Several of these oil and gas companies found a way to manage transition risks and switched to being "energy" companies, now supplying a variety of fuels, electricity, and other energy services to consumers. This step was necessary in order to guarantee the companies' market position, and governments needed them to upstream investments, mainly to boost start-up projects. So, although these companies "captured" large sums of public incentives all over the world, this became a win-win relationship (IEA 2020; Johnston and Bell 2020).

In retail electricity markets, the change has been even more dramatic. Plenty of innovative services have emerged, coupling energy and other services,[28] from car enterprises to telecommunications services, in a wide range of new suppliers. Additionally, new players have entered the market, including "organised prosumers".[29] Consequently, the companies operating in these sectors have been very busy searching for partnerships (or even mergers) that can overcome their "traditional inflexibility", and all this at a time of low profitability generated by this increase in competition.[30]

In the new energy model, electricity consumers also play a key role as service providers. Consumers will be able to support demand flexibility by simply changing their behaviour, for instance by washing laundry or charging cars at different times to usual or actively providing saving services, which they will be able to do by using smart devices. They can also sign agreements enabling a third-party (an electric company, a cooperative or even an energy community) to control their devices when necessary. Demand flexibility is even more viable and has higher potential in the industry and service sectors. Some nudges and a great deal of regulation are needed to make all this a reality (Immonen et al. 2020).

Lastly, some economic risks may also come from international trade markets and their "(in)-adaptation" to energy change and climate change commitments, mainly from the application of GATT Article XX and GATS Article XIV to transboundary exchanges. This is not only because the WTO rules treat electricity in generation as a good and electricity in transmission as a service, but also because it is taking too long to standardise the rules on "Guarantees of Origin"[31]

[27] Companies had to adapt their business from a product model to an 'energy-as-a-service' model(IRENA 2020a).

[28] Internet-of-Things (IoT) systems enable a huge amount of data to be produced by smart devices, which also communicate and exchange the data with each other. This energy data, together with technology development, is enabling the emergence of new business opportunities.

[29] Some innovative experiments on "defeating" the dominance of incumbent retail companies are arising (Kallio et al. 2020).

[30] The UK presented a regulatory strategy to address this issue where energy retail companies are responsible for actively helping consumers to reach net zero emissions (Department for Business, Energy & Industrial Strategy 2021).

[31] In Europe, the European Energy Certificate System (EECS) was created and developed as a standardisation system for the European Energy Market, but it needs to be escalated to the international level.

(of "green" electricity origin), since the difference is not in the product itself but in the way it has been produced. Hence, this may be an additional problem in international electricity commerce.

Furthermore, in recent disputes[32] we have seen strict rules on the use of subsidies that may compromise many national subsidies to renewable production and the efficiency of a global based model (Hahn and Holzer 2016) if rules are not changed in time.

3.4 Political Sustainability

Finally, sustainability in energy change cannot be determined without regard for political analyses, particularly as the energy sector has a great tradition in this domain and there has been much reflection on the geopolitics of oil and gas. Even though this change has always been aimed at addressing the "climate emergency" issue, there are those who believe it could also be a pathway to a more peaceful and fairer world.[33]

The oil and gas energy model was based on limited reserves of natural resources, located in specific countries, that could be easily transported and could feed energy economic chains in all countries. International economic relations have been shaped by this model. Inter-state alliances (including international cartels, such as OPEC) and conflicts accompanied bottlenecks of that model and aimed to protect the interests of large companies operating in those markets.

The energy transition gave rise to a different scenario. It resulted in an international political consensus based on the climate change emergency. And despite its slow advancement, it is making significant progress. Currently, huge amounts of public spending all over the world (in the form of incentives) is aiding companies and governments to promote renewable generation projects, build great transport facilities, reorganise cities and buildings, and modernise the agriculture sector. Although some major socioeconomic players are taking the lead, we see the USA, China and other international players moving cautiously and analysing in detail the political implications of all these changes.

Some of these political concerns arise due to the geographical location of rare earth material, which is now the main bottleneck of this new energy model. Then, new economic conflicts are expected to appear, as a result of the competition to be the leader in PV cells, wind generators and innovative energy technology, between China, the USA and the EU (with Germany playing a special role in this fight). Competition is now based on technology and industrial production, so countries with lower labour and environmental protection standards have a competitive 'unfair' advantage. It is not clear whether law (international law) will be able to address this issue effectively, or even whether the economic consensus genuinely wishes it to be addressed.

On the other hand, although distributed energy resources are expected to become widespread, energy demand will still be met through large scale power stations and networks. This will, essentially, demand inter-state energy relations (based on make-or-buy decisions) and integration of regional markets, in order to address the intermittent nature of renewable sources. This is totally different from the recent past. Countries will be focused on relations of proximity to ensure their energy security, given that electricity transmission is less efficient over long distances.

Meanwhile, fossil fuels will remain on the scene for some time, especially in the transportation sector, and traditional players and conflicts will not disappear immediately or in the short term, so there are no expected losers from the old-fashioned energy model for the moment.

Although the geopolitics of renewables appears to be another important field of research on energy transitions, there are relatively few publications on this topic to date (Scholten 2018). This is an intricate high-tech scenario that needs to be addressed, at a time when most

[32] Canada-Renewable Energy, WT/DS412/AR/R, 24 May 2013 and India-Solar Cells, WT/DS456/R, 24 February 2016.

[33] Replacing fossil fuel imports with local renewable generation could lead both to the end of international conflicts for these resources and to domestic employment and growth (Kjaer 2013).

nations are dealing with other political problems related to the rise of populism and the economic crisis brought about by the coronavirus pandemic. Will this energy debate help to improve democracy?

4 Energy Transition and Law

Having summarised the main challenges that lie ahead in the energy transition, and the various sustainability issues, we will now examine the role of the law in this entire process.

As previously stated, this is a global need and a societal change; a process where everyone—from individuals to institutions, from companies to governments—has a role to play. However, two preconditions will be decisive for this policy to succeed: public investment (subsidies) and confidence based on clear legal rules and simple procedures. Thus, we expect legislators to approve transparent and clear rules on funding and legal solutions for a reliable and fair regulatory context.

Therefore, the first requirement is harmonised definitions on economic law (subsidies and tax benefits), particularly on state aid regulation, be it at the global, European, or national level. We also need common rules for international trade in raw minerals and energy technology, and for electricity transboundary transactions and electricity services. In other words, we need legal certainty on international transactions similar to that which we have in the fuel-based energy sector. Only with this harmonisation will it be possible to prevent some of the legal disputes on this matter.

Secondly, we will need new rules and principles on the protection of foreign investments in the energy field. These rules must be able to define, as precisely as possible, fair risk sharing on energy projects for these singular times, where a technological revolution is expected to flourish. The rules should also address predictable issues with significant impact on costs, such as acceleration in learning curves in some experimental technologies, different availability of scarce goods (from raw minerals to land or other natural resources) or significant changes in social behaviours.[34]

Thirdly, it will be necessary to implement rules on privacy and automated procedures that strike a balance between the desired efficiency and optimisation of the new renewable electric system and the protection of human rights. In the search for an optimal system, critical data infrastructures will increase and spread, as will security needs: from cybersecurity of all facilities to personal data.

Consequently, law must create appropriate rules to allow this energy transition to flourish. This is a different approach from implementing a public policy only based on command-and-control methods. Here, the rules will mainly address instrumental issues on energy transition, such as procedures and management relating to financial support, security obligations of energy operating companies, environmental obligations, and urgent conflict resolution schemes. However, we will also need mandatory rules.

For instance, if we want this policy to be focused on a life cycle-based process, we will need clear regulation on re-use of power plant equipment at the end of its useful life, soil fertilisation after decommissioning of power plant facilities, or treatment of mining effluents. Prohibitions, licenses, and authorisations should regulate these issues using traditional administrative law mechanisms. These strict rules on the circular economy are crucial to truly make renewable energy a clean and sustainable option. That is what this is all about.

However, perhaps the most original aspect we now require of the law is an ability to address new legal duties.

Active participation of citizens in this new policy and management of their behaviour are desirable and potentially capable of having a positive impact. Yet, this entails several risks, mainly

[34] The German Government's *Energiewende* was based on support schemes that did not support a renewable technology over another, but simply provided a general direction, without specifying objectives for different renewable energy technologies, and this was considered a fundamental element in its success (Kuittinen and Velte 2018).

the risk of intensifying inequality and unequal treatment if we simply use price regulation and other nudging mechanisms of an economic regulation nature. The problem here is not different levels of willingness to pay (that can lead to ineffective results) but different levels of ability to pay, that can lead to economic discrimination. For instance, if we simply let demand regulation be governed by contract savings in which supplying companies offer different discounts based on the willingness/ability of consumers to support those savings, we will let citizens with limited budgets bear the demand peaks just because they do not all have the same options when choosing the electricity tariff and rate discounts.[35]

This is a moral and ethical market failure, and the law should provide regulators with *legal tools* to guarantee a *minimum* level field in the energy transition. This means that energy savings must affect all consumers, though they can affect them to different extents.

Engaging citizens in the energy transition also creates the need for new legal duties and obligations. A communitarian legal duty exists when someone is legally compelled to act responsibly towards others, according to the law. Energy saving and energy sharing can be universally considered communitarian duties. In fact, they cannot be classified as restrictions to individual rights, nor do they affect property rights. In some legal situations, the legislator should properly identify the obligation to share energy or to save energy, valued at a regulated price. This obligation is a communitarian and cooperative means of achieving a common societal goal. Since it is a universal commitment, it is also an ethical denominator of the policy.

Likewise, adopting a standard for investors' due diligence obligations when evaluating their legitimate expectations is a kind of energy self-awareness duty. It cannot be seen as a tough burden on risk sharing. On the contrary, if we do not adopt such an evaluation standard, we will be giving energy investors an unfair advantage compared to other investors. We must not forget that these investors will be receiving enormous amounts of public money to cooperate with states and society in this decisive task. Thus, fair collaboration means that no speculation (i.e. unreasonable or opportunistic gain) is acceptable.

Inefficiencies in this global and complex operation can compromise the future of the generations to come. Avoiding them is a guiding principle and a foundation for all these duties, which can also be interpreted as part of the human dignity principle. If we—Society— are investing a generational budget in this change in the economic development model, we have a "special duty of care" regarding this budget. All possible windfall gains must be low or invested in the interest of the next generations.

5 Conclusion

The energy transition is a generational task which seeks to mitigate the negative effects of the industrial revolution on the development opportunities of future generations. This is a kind of settling of accounts between generations. The current generation is attempting to fix decades of pollution and depletion of natural resources through an ambitious action plan. No-one is allowed to fail. This demands a complex, intricate and global policy that defines its path as it goes forward. Imagination, flexibility, fairness, and reasonableness are the keys to success at all levels. Regulating the energy transition is no exception.

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[35] We can find other examples of what Michael Sandel calls things that money can't buy (Sandel 2013).

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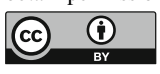

The Impact of Ecolabels and Green Taxes on Market Outcomes

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Abstract

Ecolabels and green taxes aim to achieve more sustainable market outcomes by affecting suppliers' production and sales behaviour, consumers' purchasing behaviour, or both. In this chapter, we present the economic rationale for how these approaches may impact suppliers and consumers in various settings and review recent published empirical research on the topic. We focus specifically on examples where ecolabels and green taxes have been used to protect oceans and fisheries by reducing plastic waste and reducing purchases of less sustainable seafood. We conclude by discussing other possible policy instruments and highlight important avenues for future work in pursuing more sustainable market outcomes.

Keywords

Ocean sustainability · Plastic pollution · Ecolabels · Green taxes · Market outcomes · Empirical evidence

1 Introduction

The oceans contain less life and more plastic than many policymakers and academic researchers would prefer. In most marine fisheries, the rate of fishing exceeds the catch-maximizing and profit-maximizing rates, resulting in depleted ecosystems, less food for people, and lower profits for the world's 39 million fishers (Costello et al. 2016; Food and Agriculture Organization 2020). The 10 to 20 million tons of plastic that enter the ocean each year further degrades marine environments (United Nations Environment Programme 2014). Conservation organizations seeking to reduce pollution and over-fishing by promoting better fishing practices have increasingly turned to market-based mechanisms such as environmental sustainability labels (eco-labels), taxes, bans or other instruments, in order to shift patterns of suppliers and of household consumption.

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This chapter starts by laying out the economic rationale for how these market-based mechanisms may impact suppliers and consumers. Then it focuses on examples where ecolabels and green taxes have been used to protect oceans and fisheries. It ends by discussing challenges and other possible policy instruments to promote sustainable market outcomes in the oceans and fisheries supply chain.

2 Economic Theory and Policy

Private markets—those without government intervention—often fail to allocate goods in a socially optimal way. This is particularly true for environmental goods, such as oceans and fisheries, which are not owned by any one country or individual. When private markets fail or simply do not exist, economic theory provides a strong rationale for governments to intervene to correct the failures. In this section, we describe three ways in which markets fail with respect to oceans and fisheries and discuss policy tools that can be used to address these market failures.

2.1 Market Failure 1: Open-Access Resources

The first market failure we consider relates to property rights, or the lack thereof. Since nobody owns the oceans or fisheries, no one country or individual has sufficient incentive to protect these resources or to harvest them responsibly. This leads to overuse and overharvesting. Economists refer to these types of resources as open-access: anyone may access them, but one person's use of the resource depletes what is left for everyone else. The overuse problem that arises from open-access resources is commonly referred to as the "Tragedy of the Commons" (Hardin 1968).

The economic policy solution for open-access resources is to assign property rights to the resource. In other words, governments can use policy tools to convert open-access resources into resources such that users behave as if they "own" the resource. In the case of fisheries, the regulator sets a cap on the total quantity of fish that can be caught each season and distributes a portion of that cap to each fishing vessel. In addition to increasing economic profits, property rights-based instruments increase the size of fish populations and reduce the probability of fisheries "collapse" (Costello et al. 2008, 2016; Isaksen and Richter 2019).

2.2 Market Failure 2: Negative Externalities

A second way that markets can fail is due to negative externalities. Negative externalities occur when the consumption or production decisions of one person or firm negatively affect another person or firm without their permission or compensation. For instance, when firms decide how much plastic packaging to use and when consumers decide how much plastic packaging to buy, they often do not consider the costs that their plastic packaging waste will impose on society and the environment (in particular, oceans and the wildlife therein). It is estimated that 2–5% of plastic waste is mismanaged and enters the ocean each year (Jambeck et al. 2015). Once in waterways, plastic items do not biodegrade but, instead, break into smaller pieces, which sea animals can consume, mistaking them for food (Wilcox et al. 2016). Globally, the cost of plastic pollution in the ocean, from the consumer goods industry alone, is $13 billion annually (United Nations Environment Programme 2014).[1] Since the price of plastic packaging that firms and consumers see in the marketplace does not reflect these external costs, it leads them to produce and consume more plastic packaging than is socially optimal.

However, there are several economic policy tools for addressing negative externalities. First, there are *market-based incentives* which, by altering the prices seen in the marketplace, encourage

[1] Moreover, this cost estimate is most likely a significant underestimate because it focuses on direct plastic use and does not include certain downstream impacts, such as those caused by microplastics.

consumers and firms to adjust their behaviour. Taxes and fees can be used to increase the price of behaviours that are harmful to the environment (e.g., a 5-cent tax for using disposable plastic shopping bags) and thus discourage people from engaging in these behaviours. Similarly, subsidies and bonuses can be used to reduce the price of behaviours that benefit the environment (i.e., a 10-cent discount for bringing a reusable mug to your local coffee shop), and thus encourage green behaviours. Market-based incentives are often the preferred policy tool of economists due to their flexibility and the fact that they make polluters internalize the costs of their pollution. However, taxes can be politically challenging to implement, and subsidies can be expensive.

An alternative approach to market-based incentives are *command-and-control policies*, which set standards for which behaviours firms and consumers can and cannot adopt. For instance, command-and-control policies may ban certain actions or products, such as banning the use of Styrofoam in take-away containers or banning the catch of fish below a certain size. Command-and-control policies may also require the use of certain technologies or require technologies to meet specific standards, such as requiring shrimp trawlers to use turtle excluder devices in their nets. Command-and-control policies have the advantage of being simple to monitor; however, once their standards are met, they do not create incentives to find better ways to reduce pollution. Furthermore, they may lead to unintended consequences that undermine their benefits, such as when consumers and firms look for ways to circumvent the regulations.

A third set of policy tools are called *nudges*. Unlike market-based incentives and command-and-control policies, nudges do not forbid any behaviours or actions, nor do they change economic incentives through prices. Instead, nudges change the environment in which choices are made, so that a person will be more likely to make a particular choice or behave in a particular way. One example of a nudge policy is changing the default option. People tend to stick with the default option because there is more hassle involved in changing away from the default. If the default option is a behaviour that is good for the environment, then people will be more likely to adopt this green behaviour. For instance, restaurants often provide plastic straws with their beverages as the default. If the customer does not want to use a straw, they would have to ask the restaurant not to give them one. However, if instead beverages came without straws and people had to ask for a straw if they wanted one, this change in the default would most likely lead to many fewer plastic straws being used.

2.3 Market Failure 3: Incomplete Information

For markets to work, everyone in the market (both consumers and producers) needs to have complete information about what is going on in the market. For example, without complete information about a good, consumers will not know how much they value that good or how much of that good they want to purchase. If a person cannot tell whether a sandwich is a tuna-salad sandwich, a chicken-salad sandwich, or an egg-salad sandwich, they may not want to pay very much or they may not want to purchase the sandwich at all. Thus, incomplete information is another reason markets fail.

In the case of environmental goods, consumers cannot always tell if a product was produced in an environmentally friendly manner. Consumers may want to support businesses that act in sustainable ways, but if the consumers cannot tell which products are sustainably produced, there is no incentive for producers to create these environmentally friendly products. One policy solution to combat incomplete information is to develop ecolabel certification schemes. Ecolabels provide consumers with information about which products meet standards for environmental sustainability and which do not, which enables consumers to support companies that are stewarding the Earth's resources. However, for ecolabels to work, they need to be trustworthy and credible. Thus, third-party certifiers (i.e., not

the producers of the product) are often used to create industry standards and monitor the certification process.

3 Pollution Initiatives and Ecolabel Certification Schemes

Of the approximately 300 million tons of plastic produced each year, 10 to 20 million tons enter the ocean (United Nations Environment Programme 2014). Even if governments and firms meet 100% of their current commitments, a recent estimate in *Science* predicts this flow of plastic into the ocean will more than double by 2040 (Lau et al. 2020).

Plastic pollution in the ocean harms both people and animals. The damage caused by a single component of plastic pollution to a single region is striking: the cost of removing plastic from Europe's coastlines is €630 million annually (United Nations Environment Programme 2018). Globally, the cost of plastic pollution in the ocean is $13 billion annually (United Nations Environment Programme 2014). This estimate equals global cleanup costs plus the estimated damage to the fishing, tourism, and shipping industries. A recent review of the effects of pollution on marine animals found that 82% of impacts are due to plastic pollution (Rochman et al. 2016).

Several recent articles detail the numerous international, regional, national, and subnational regulations, laws, and initiatives to reduce plastic pollution in the ocean (Schnurr et al. 2018; United Nations Environment Programme 2018; da Costa et al. 2020). Figures 1 and 2 demonstrate the geographic breadth of plastic bag (Fig. 1) and microbead (Fig. 2) taxes, bans, and other regulatory interventions (Schnurr et al. 2018). Nearly 150 countries have implemented a plastic bag tax, ban, or other regulatory intervention (da Costa et al. 2020). Yet, given that the flow of plastic pollution into the ocean remains high, and is even predicted to more than double by 2040 (Lau et al. 2020), it seems that existing policies have yet to significantly reduce plastic pollution at the global level. However, national and subnational evidence of the effectiveness of plastic taxes and bans does exist. We summarize this evidence in the next section.

"Ecolabels" on seafood products help consumers make informed purchasing decisions. By signalling that a product originates from a sustainable fishery, ecolabels can increase demand for sustainable seafood products, increasing the share of fisheries that are managed sustainably.

The Marine Stewardship Council (MSC) is perhaps the most rigorous and best-known certification organization (World Wildlife Fund 2012; Miller and Bush 2015). Fisheries that wish to display the MSC logo on their products pay a third-party auditor to investigate their fishery and compare it to the MSC's standards. Certified fisheries pay for annual audits and recertification every five years, and they also pay MSC an annual licensing fee. As of 2020, 409 fisheries were MSC-certified. Together these fisheries represent 15% of the global marine catch (Marine Stewardship Council 2020). The cost of certification ($15,000 to $120,000), annual audits ($75,000 by one estimate), and the annual licensing fee (0.3% to 0.5% of revenue plus a fixed fee) preclude small-scale fisheries from receiving MSC certification (Bauman 2009; Marine Stewardship Council 2021a, 2021b).

Many other organizations also certify seafood with ecolabels, including the Monterey Bay Aquarium's Seafood Watch, Ocean Wise, and FishWise. Other certification organizations may use different standards to those of the MSC, may limit their certification activities to one country or region, and may certify fisheries "proactively", as opposed to requiring fisheries to pay a third-party auditing firm for certification. Given the many different types of co-existing seafood ecolabels, using one consistent ecolabel may be more effective at communicating clear information to consumers (Federal Trade Commission 2010). We summarize research on the effect of ecolabels on consumer purchases in the next section.

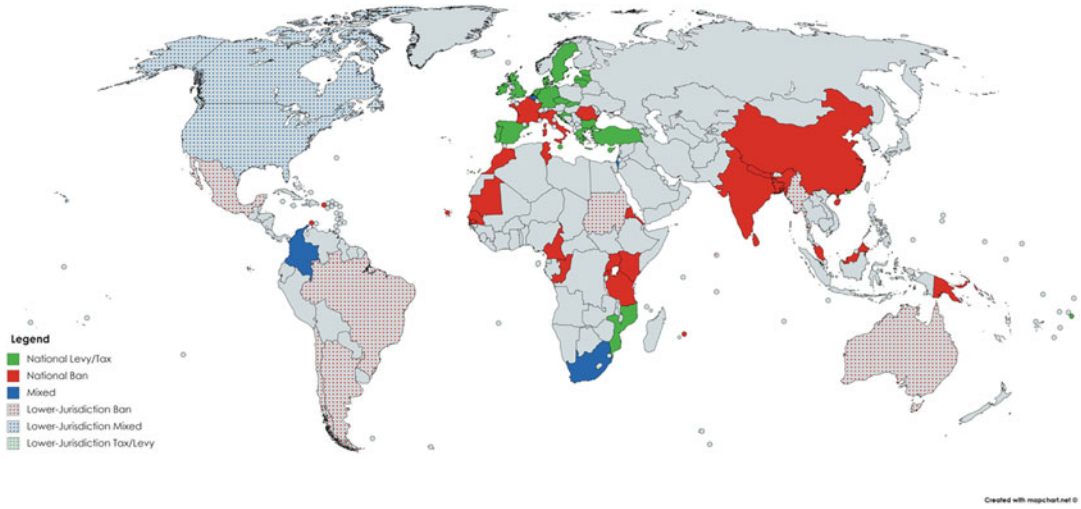

Fig. 1 Global plastic bag interventions, as of 2018. Reproduced with the permission of Schnurr et al. (2018)

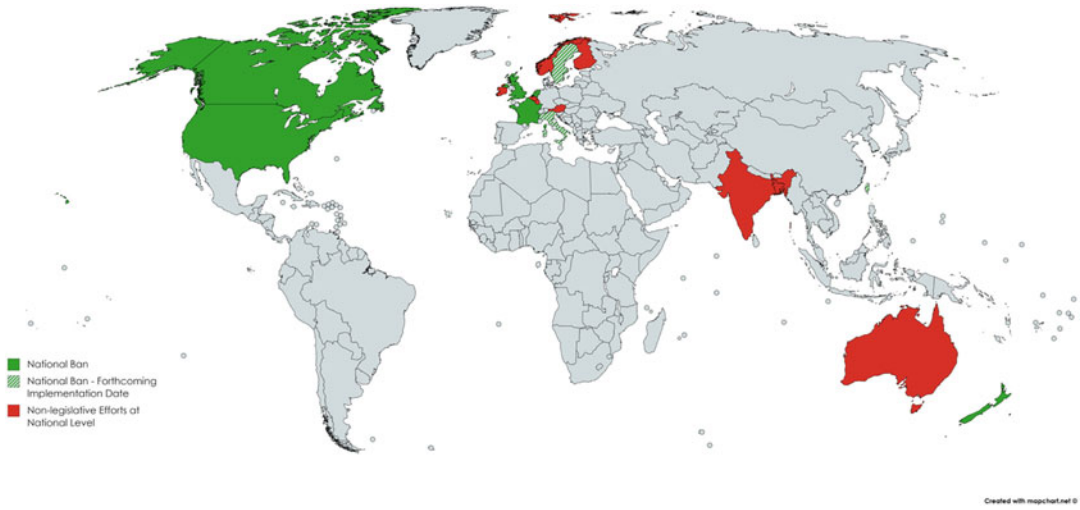

Fig. 2 Global microbead interventions, as of 2018. Reproduced with the permission of Schnurr et al. (2018)

4 Empirical Evidence on How Green Taxes and Ecolabels Impact Oceans and Fisheries

4.1 Evidence on Plastic Ban and Tax Policies

Plastic bans have been widely used with respect to disposable plastic shopping bags, plastic straws, and plastic microbeads in cosmetic products. These command-and-control policies ban products that do not meet certain standards. In the case of bag bans, these policies generally ban the distribution of plastic bags under a certain thickness (such as 2.25 thousandths of an inch thick). While bans have been shown to be effective in reducing the use of the item being banned, they can also lead to unintended consequences that undermine the effectiveness of the bans.

Bags bans in California reduced plastic shopping bag usage by 40 million pounds (over 18 million kilograms) per year (Taylor 2019). However,

this reduction was offset by a 12-million-pound (5.5-million-kilogram) annual increase in trash bag sales, since prior to the ban some people reused their plastic shopping bags as trash bags (Taylor 2019). This meant nearly 30 percent of the plastic eliminated by the ban came back in the form of trash bags, which are thicker than typical plastic shopping bags. Thus, the bag bans not only banned the 'brown' behaviour of using too many plastic shopping bags, but also banned the 'green' behaviour of reusing shopping bags as garbage bags (which is a green behaviour because it prevents the production and sale of an additional plastic bag). Another unintended consequence was that after California banned thin plastic shopping bags, the new default in many stores became paper bags. As a consequence, paper bag usage increased by 83 million pounds (37.6 million kilograms) annually (more than double the weight of the banned plastic bags) (Taylor 2019). While paper is less environmentally damaging than plastic as a source of litter because paper biodegrades, paper is much more carbon intensive than plastic throughout its lifecycle. Thus, the global warming impacts of paper as the new default are concerning.

Other studies have also found unintended consequences of plastic bag bans. For example, Chicago implemented a plastic shopping bag ban in 2015 and then repealed it in 2017. Counter to the policy's goal, stores bypassed the regulation by offering customers free thick plastic bags, which were roughly five times the thickness of the standard plastic shopping bags that were on offer prior to the ban (Homonoff et al. 2021). Thus, the ban shifted customers toward more environmentally harmful products.

An alternative policy to bag bans are bag taxes. Instead of banning plastic shopping bags, bag taxes impose a small fee (generally 5 to 10 cents) for using these bags. One study compared the outcomes of bag bans and bag fees and found that bag fees are as effective as bag bans at reducing disposable bag use, but they have the additional benefit of not increasing paper bag use (Taylor and Villas-Boas 2015). Similarly, an analysis comparing bag bans and bag taxes in Chicago found that the taxes did not lead to the unintended increase in thicker plastic shopping bags (Homonoff et al. 2021). Given these results, we recommend policymakers consider plastic taxes (market-based incentives) over bans (command-and-control policies). However, if a tax is not politically feasible, the design of bag bans can be improved if they also consider what substitutes consumers might switch to. For instance, bag ban policies can also require that all remaining types of bags on offer have a price so that thicker bags are not given out for free. Plastic bag taxes have also been shown to be effective policy tools for discouraging plastic bag use and encouraging reusable bag use in Buenos Aires (Jakovcevic et al. 2014), Uruguay (Cabrera et al. 2021), Toronto (Rivers et al. 2017), and Wales (Poortinga et al. 2013).

A few studies have also examined reusable bag subsidies and nudges. A study of the 5-cent reusable bag bonus in the Washington D.C. area found the bag bonus had no effect on the rate at which consumers brought reusable bags (Homonoff 2018). A second paper implemented a small field experiment using a charitable donation nudge (Penn et al. 2021). Shoppers who chose to forego the use of a plastic bag were given a token that they could use to make a donation to a charity (Penn et al. 2021). This field experiment found that the token-donation program reduced the probability of plastic bag use by 12 percentage points (Penn et al. 2021). Therefore, subsidies have not been found to be effective policies (with respect to reusable bag usage), while there is some evidence that nudge policies may be effective at reducing plastic bag use. However, the ability for this type of nudge to scale has not been studied.

In addition to plastic bags, lightweight plastic bottles are another major contributor to ocean plastic pollution with negative impacts on marine ecosystems (Barnes et al. 2009). Water and carbonated beverages, such as soda, are frequently sold in polyethylene terephthalate (PET) bottles that can end up in waterways and oceans. Policymakers have attempted to reduce littering and plastic bottle pollution using several tax-based and non-tax-based programs, with varying success.

One paper evaluated how a tax on bottled water in the state of Washington impacted consumers' bottled water purchases (Berck et al. 2016). Using weekly product-level sales data from large retailers in Washington and neighbouring states, these authors found that after the implementation of a tax of around nine percent, consumer purchases of bottled water fell by roughly six percent. When the tax was repealed, consumer purchases rebounded somewhat, remaining roughly three percent below baseline levels. These results suggest that consumer demand for bottled water is fairly inelastic, or insensitive to changes in price. Consequently, taxing bottled water seems to be a relatively inefficient way to reduce purchases of PET bottles. Furthermore, it is not clear that reducing purchases of plastic bottles would result in a similar reduction in plastic litter since consumers that contribute to plastic pollution may not be the same consumers who change their purchasing behaviour because of a tax.

An alternative policy targeting plastic bottle pollution relies on deposit-refund recycling programs. In these programs, consumers pay a small tax when they purchase a product and are then able to redeem the empty container for a tax refund. The California Redemption Value (CRV) is one such recycling program that currently pays five cents for a container smaller than 24 liquid ounces and ten cents for larger containers. Well-designed deposit-refund programs can replicate the effects of a pollution tax and are frequently easier to implement than a tax on litter (Fullerton and Wolverton 2000). Crucially, these programs provide an incentive for individuals to move plastic bottles from the waste stream and the natural environment to the recycling stream. Moreover, the original consumer does not need to be the person who claims the refund payment. In California's CRV program, for example, so-called "scavengers" play an important role in diverting recyclable material from the waste stream to local recycling centres (Ashenmiller 2009; Berck et al. 2018, 2021). By better targeting the negative externality (littering), deposit-refund recycling programs are likely to be more effective at reducing plastic waste than taxes on plastic bottles (Stevens et al. 2016).

4.2 Evidence on Ecolabels

In the context of shifting toward more sustainable fisheries, operators in the supply chain of commercial fishing consider demand side factors, such as customer sustainability preferences, as well as supply side forces pertaining to the management of species. They make strategic decisions on where and how much to fish subject to regulatory oversight across species groups and management bodies (Watson and Pauly 2001; Delgado et al. 2003; Costello et al. 2008; Smith et al. 2010). Taken together, they then make strategic choices on investments in sustainable practices and how to credibly convey to consumers the sustainable characteristics of these fishing and supply chain practices. Credible information that is valued by consumers results in product differentiation and, consequently, in the ability to incorporate into final prices any upstream costs of improvements in sustainability practices.

Environmental sustainability labels, or ecolabels, are the main means by which firms differentiate their products (Asche et al. 2015; Blomquist et al. 2015). In 2002, one of the early studies using consumer purchase data confirmed that the dolphin-safe tuna label increased the market share of canned tuna (Teisl et al. 2002). Beyond average consumer responses, subsequent research has found different impacts of seafood risk advisories for certain population groups (Shimshack et al. 2007; Teisl et al. 2011).

A large portion of the existing research on consumer-focused mechanisms, such as ecolabels and other product attributes associated with environmental sustainability, has relied heavily on attitudinal and knowledge surveys, consumer choice experiments, and experimental auctions (Johnston et al. 2001; Alfnes et al. 2006; Johnston and Roheim 2006). For instance, one 2001 study found international differences in factors affecting how consumers value ecolabels (Johnston et al. 2001). While these studies offer valuable

insight and methodological approaches, one potential weakness is that they capture consumers' stated preferences rather than their actual behaviours. There can be great disparity between consumers' stated preferences and their actual purchases (Hensher and Bradley 1993).

In the literature on revealed preference, based on actual market outcomes rather than surveys, hedonic price models have been used to estimate relative values for seafood product attributes, such as catch method, fishing gear choice, country of origin, product colour (of salmon), and environmental sustainability (McConnell and Strand 2000; Carroll et al. 2001; Jaffry et al. 2004; Roheim et al. 2007, 2011; Asche and Guillen 2012; Sogn-Grundvåg et al. 2013). Hedonic models relate the price of products to their attributes and estimate the marginal effect of sustainable attributes on prices, controlling for other factors. Another empirical approach is to estimate choice models using demand system analyses (Teisl et al. 2011; Sun et al. 2017), and case study approaches (Roheim 2003). In terms of the main conclusions drawn, the above-mentioned study on the dolphin-safe tuna label used consumer purchase data to confirm that the label increased the market share of canned tuna bearing that label (Teisl et al. 2011). Another study, from 2011, applied a hedonic price function approach to scanner data on the sale of frozen processed Alaskan Pollock in the London metropolitan market, to estimate a statistically significant price premium for Marine Stewardship Council certification (Roheim et al. 2011). Lastly, research from 2013 estimated quantity responses to a sustainability label system, and surprisingly found that sales of yellow-rated labelled products decreased significantly in treatment stores relative to controls, while red- and green-rated labelled products saw no change in the quantity sold (Hallstein and Villas-Boas 2013). The most recent published empirical work investigates whether consumers are willing to pay for sustainability in seafood purchases. This 2019 paper estimates consumers' dollar value willingness to pay (WTP) for the environmental information provided by the ecolabels and other product attributes (Hilger et al. 2018).

In conclusion, the empirical literature finds promising evidence that seafood ecolabels are associated with shifts in market demand toward more sustainable choices and away from less sustainable alternatives. The policy implication is that consumer-focused mechanisms, such as ecolabels and certification, have market-level impacts and are an effective tool for sustainable fisheries management.

5 Other Policy Instruments Promoting Sustainable Oceans and Fisheries

Countries have the exclusive right to harvest and manage all resources within their Exclusive Economic Zones (EEZs). The codification of EEZs between 1973 and 1982 at the third UN Conference on the Law of the Sea, and the declaration of EEZs by countries (mostly in the 1970s and 1980s), represent the most significant advance toward fisheries sustainability in world history because EEZs enable countries to manage their fisheries (Wilen 2000; Hannesson 2013). EEZs also incentivize fisheries enforcement because the more unauthorized fishing that countries prevent, the more fish available for the country to use (Englander 2019). EEZs typically extend 200 nautical miles (370 km) from a country's coast. Together, EEZs cover 39% of the ocean's surface and are the source of more than 95% of global marine fish catch (Pauly and Zeller 2015).

Prior to EEZs, countries were typically only recognized as having exclusive rights within three nautical miles of their coasts (Hannesson 2013). This condition of "open-access", which prior to EEZs applied to the vast majority of fishing grounds, leads to the depletion of fish stocks and the dissipation of economic profits because each fisher does not account for the fact that their fishing harms other fishers (by reducing the amount of fish available to other fishers). In open-access, fishers fish too much relative to the amount of fishing that would occur in a fishery in which the total amount of fishing was chosen to maximize total profit or total catch.

With EEZs, countries choose how to manage their fisheries. In a "regulated open-access" fishery, the regulator sets a total allowable catch (TAC) limit—the total tons or number of fish that can be caught that season by all fishers (Reimer and Wilen 2013). TAC limits prevent biological depletion, but they do not prevent the dissipation of economic profits because fishers "race to fish" before the TAC is reached, which increases fishing costs (Birkenbach et al. 2017). Regulators may also limit the entry of new vessels into the fishery, remove vessels from the fishery through "buy back" programs, limit fishing to certain time periods or areas, and limit fishing "inputs" (such as size of vessels or types of fishing equipment), but, similarly to the TAC limits, these measures do not preserve economic profits.

Property rights-based instruments distribute a share of the TAC to each vessel, which reduces the "race to fish" because each vessel knows they will (almost certainly) be able to catch their share, even if they fish more flexibly over time (Birkenbach et al. 2017). In addition to increasing economic profits, rights-based instruments increase the size of fish populations and reduce the probability of fisheries "collapse" (Costello et al. 2008, 2016; Isaksen and Richter 2019). Property rights-based instruments are perhaps the best tool available to countries to maximize the profit and sustainability of their fishing industries.

Beyond EEZs lie the high seas, or Areas Beyond National Jurisdiction. Regional Fisheries Management Organizations (RFMOs) regulate fishing for a particular region and/or species, but sustainable management of high seas fisheries is limited by RFMOs' decision-making process, which typically either requires consensus or allows countries to opt-out of regulations they disagree with (Haas et al. 2020). Furthermore, only the flag state (the country the vessel is registered to) can punish deviant vessels, and not every country is willing and able to punish their vessels.

The Agreement on Port State Measures, which was ratified in 2016, is one of the most promising tools for high seas enforcement because it permits countries (port states) to block vessels that have engaged in illegal, unreported, or unregulated (IUU) fishing from using their ports (Witbooi 2014). Denying port access to these vessels reduces their ability to sell their fish, which reduces the benefit to vessels of IUU fishing on the high seas in the first place. Additionally, the intergovernmental conference to create a new, legally binding treaty for the high seas held its first session in 2018 and its fourth session is scheduled for 2022 (United Nations General Assembly 2018). This potential treaty could create marine protected areas on the high seas for the first time (United Nations General Assembly 2021).

6 Challenges and Avenues for Future Work for Local and Global Communities

Protecting the oceans involves many complex challenges for local coastal regions, specifically, and for the global community in general. There has been a promising myriad of global and local initiatives to address overfishing and other illegal fishing practices, to improve traceability of the fishing supply chain, to address co-existing problems of human right issues, and to promote social responsibility and fair practices in fisheries. Some of the international initiatives have been decades in the making, while others are emerging as new issues are identified.

In Fig. 3 we can see the number of local and global efforts that world regions engage in to improve traceability, improve social responsibility, or reduce illegal, unreported, and unauthorized fishing. If we examine the number of global or local efforts in relation to a country's population or gross domestic product, we find that the degree to which countries participate in these efforts differs somewhat. While North America and Southeast Asia lead the world in terms of total efforts, Northern Europe ranks number one when total efforts are normalized by regional population or GDP.

At country level, the increasing use of property rights-based instruments to manage fisheries is a cause for optimism. Continued international

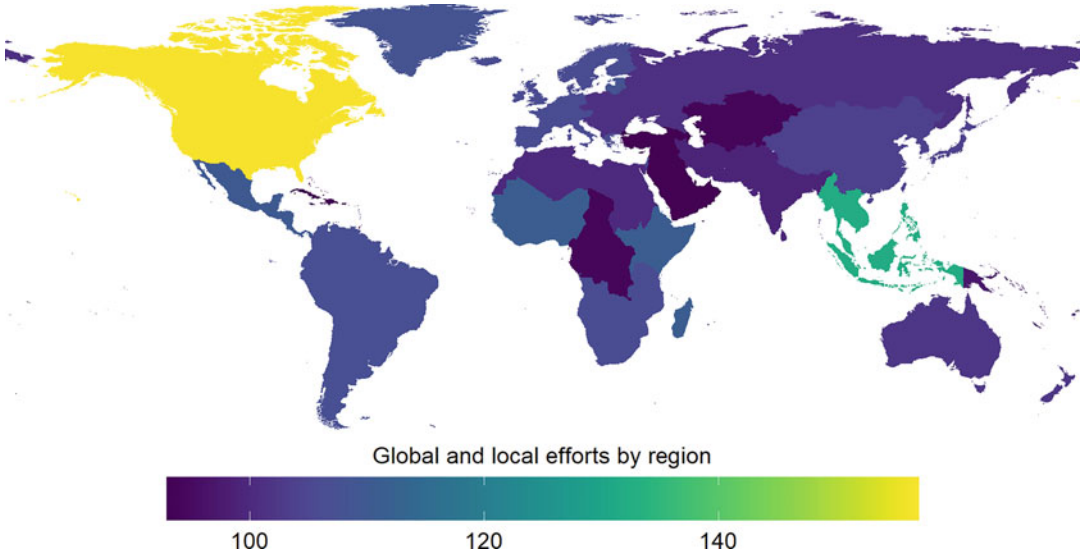

Fig. 3 Number of global and local efforts to improve traceability, improve social responsibility, or reduce illegal, unreported, and unauthorized fishing, as of 2021 (Map elaborated by us based on the data supplied by SALT—Seafood Alliance for Legality & Traceability, in www.salttraceabilty.org)

cooperation is needed to improve management of fish stocks that occur in multiple countries' waters or on the high seas. Promising avenues for international cooperation include the ongoing negotiations at the World Trade Organization to reduce fishing subsidies, the ongoing negotiations to create a new, legally binding treaty for the high seas, efforts to reform the decision-making process of Regional Fisheries Management Organizations, and the implementation of the Port State Measures Agreement. Finally, the increasing use of satellites to monitor fishing activity will enable countries to enforce the laws and treaties they enact and ratify.

There are also promising signs of progress toward reducing plastic pollution in oceans. In 2019, the United Nations amended the Basel Convention, which controls transboundary movements of hazardous wastes and their disposable, to include many forms of plastic waste. The 187 signatory countries will be required to track plastic waste outside their own borders and will be prohibited from exporting plastic waste unless they have obtained written permission from the recipient country (United Nations Environment Programme 2020). In 2020, the European Union passed a tax on nonrecycled plastic packaging waste equal to €0.80 per kilogram. The member countries can choose whether and how they pass a plastic tax of their own to recover the tax paid to the EU. How these policies will impact plastic demand and waste is an open question needing further empirical research.

While there are promising international plastic waste policies on the horizon, there is also a concerning trend of governments prohibiting the regulation of plastic. As of August 2019, 17 states in the US had passed preemption laws that prohibit local governments from regulating (i.e., banning or taxing) various plastic items (Treskon and Doctor 2020). Supporters of these preemption laws argue that local plastic regulations create a patchwork of laws that confuse customers and hurt businesses. However, there is little empirical evidence that the patchwork of local regulations itself harms consumers and businesses (Treskon et al. 2021). Thus increasingly, the policy tools available to local governments are limited when it comes to plastic waste.

7 Conclusion

Marketplace signals, such as green taxes, bans, and eco-labels are purported to economically reward successful stewardship and penalize pollution and overfishing. In theory, eco-labels provide consumers with easy-to-use relative information, allowing the differentiation of products. From the commercial fishery operation's perspective, the utility of eco-labels is their ability to differentiate their products along sustainable attributes. This differentiation may allow the passing of increased costs associated with best practices onto consumers who value sustainability.

Similarly, when addressing plastic pollution of the oceans, taxes may shift choices towards untaxed products, such as reusable bags, and lead to lower plastic ocean pollution. While empirical evidence is promising there are other instruments available to policymakers and international organizations to achieve lower pollution of the oceans and reduce overfishing. The challenges are many, but the rewards are healthier and more productive oceans.

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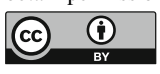

Environmental Governance Through Tax Law in the European Union

Marta Villar Ezcurra and Jerónimo Maillo González-Orús

Abstract

The contribution considers critical issues in European environmental governance, focusing on the role of legal principles, fundamentals and competences, and also a review of sectoral legislation in the field of taxation related to EU climate, environment and energy policies. The role of tax harmonisation to favour the ecological transition, the 'Fit for 55' legislative package and the reform of the EU's own resources are some of the topics specifically addressed. For the ambitious strategy of the European green deal to be truly successful, governance must be strengthened, especially in the areas of environment, energy and taxation, because it is necessary to mobilise investments and plan infrastructures and interconnections. The intersection between fiscal and competition policy (above all State Aid Law) can also play a very important role in fostering the right green investments, both from Member States and private actors.

Keywords

Governance · European Union · Tax law and harmonization · Climate change · Energy · State Aid and Competition Law

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1 Introduction

Tackling climate challenges and achieving the objectives of the Paris Agreement[1] are at the core of the European Green Deal (EGD).[2] Environmental and energy policies have recently taken centre stage in the EU's policymaking, since the EGD is the main driver of the Union's economic growth strategy.

To deliver reductions in greenhouse gas emissions and meet climate ambitions in line with the European Climate Law,[3] the European Commission has proposed a set of measures

[1] At the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), which took place in Paris from 30 November to 12 December 2015, the text of an agreement was adopted, concerning the strengthening of the global response to climate change. See Council Decision (EU) 2016/1841 of 5 October 2016 on the conclusion, on behalf of the EU, of the Agreement adopted under the United Nations Framework Convention on Climate Change (OJ L 282, 19 of October 2016).

[2] The European Green Deal, presented in the Communication (COM(2019)640) of 11 December 2019, sets out a detailed vision to make Europe the first climate-neutral continent by 2050, safeguard biodiversity, establish a circular economy and eliminate pollution, while boosting the competitiveness of European industry and ensuring a just transition for the regions and workers affected.

[3] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('-European Climate Law'). See OJ of 9 of July 2021, L 243/1.

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called the Fit for 55 package.[4] A broad revision of relevant climate and energy legislation will be adopted in a package covering, *inter alia*, energy taxation, renewables, energy efficiency, land use, CO_2 emission performance standards for light-duty vehicles, effort sharing and the EU emission trading system (EU ETS). These initiatives are complemented by a huge financial package to accelerate economic recovery in Europe.

This Chapter considers critical issues in European environmental governance, focusing on the role of legal principles (among others, the polluter pays principle—PPP), fundamentals and competences, and also a review of sectoral legislation in the field of taxation related to EU climate, environment and energy policies. In this context, the role of tax harmonisation and its coordination with the EU ETS to favour the ecological transition is an issue specifically addressed as a strategic and singular path in the EU.

Accordingly, the Chapter begins with an overview of European environmental governance, particularly after the EGD and the 2021 European Climate Law. Under this heading, we discuss the key legal principles and how they might interact with each other, competences shared between the EU and Member States on environment, energy and tax matters, and the importance of the adjusted EU State aid framework for climate, environmental protection and energy. The chapter then addresses the role of environmental taxes and harmonisation of these, as well as discussing the European Emission Trade System. Following this, we highlight the new tax framework proposed and brought forward by the EGD, in particular by the Fit for 55 legislative package and the reform of the EU's own resources. Lastly, some conclusions and recommendations for the near future are presented.

[4] Communication from the Commission ''Fit for 55': delivering the EU's Climate target on the way to climate neutrality', Brussels, 14 of July 2021 (COM(2021)550 final).

2 European Environmental Governance

According to Article 3 of the Treaty on European Union (TEU), the Union is committed to a 'high level of protection and improvement of the quality of the environment', which includes combating climate change. Furthermore, other provisions of EU primary law develop this commitment, in particular Articles 11 and 191–193 of the Treaty on the Functioning of the European Union (TFEU), covering environmental policy. Article 11 stresses the broad-ranging nature of this goal and the need to take environmental considerations into account in other EU policies. This implies that the Union will need to use many other policies to foster progress in environmental protection. Greening many other EU policies is essential if quick and effective progress is to be made. Furthermore, the Union shares competences with Member States (MS), regions and local actors, which also have a key role to play. And the Union itself has the important task of participating in international negotiations and establishing commitments at bilateral, multilateral and global levels. All this demonstrates the need for multi-level governance and the complexity of this (See, among others, Scott 2011).

In practice, under this legal framework, in recent decades the EU has enhanced its very important role (both within the EU and beyond) in environmental and climate change issues, and has made a particularly notable contribution to raising the bar as regards the objectives to be achieved and laying the foundations for influential programmes, plans, agendas and roadmaps. To do this, it has adopted European legislation, harmonised national rules and, at the same time, coordinated the work of the Member States. It has also played a transcendental role, as a global leader, in climate summits. The new Von der Leyen Commission has established this goal as a top priority and launched the European Green Deal and the Climate Change Law. Overall, the EU is recognised as an ambitious and committed leader that sets an example and seeks consensus to raise ambitions regarding protection of

biodiversity and the environment and in the fight against climate change.

However, the Union still has some very important limitations. Firstly, since in many cases it will be acting in areas of shared competences, in order to act it must demonstrate that it will be more efficient than the MS, which may have different priorities or rhythms. Secondly, decisions at European level are not always taken by majority. Issues as important as (i) taxation, (ii) town and country planning, (iii) quantitative management of water resources or (iv) land use (except waste management) remain under the unanimous voting rule. The decision on the energy mix in each country is also reserved for each State. Thirdly, certain challenges require global action and consensus.

With regard to green public spending, the EU has also promoted important green investments through different programmes and funds, such as the European Structural and Investment Funds or, more specifically, the Programme for Environment and Climate Action (LIFE), which was the EU's main financial instrument dedicated to the environment for the period 2014–2020.

More recently, the next generation fund approved to combat the coronavirus pandemic and foster economic recovery has considerably increased this spending for the next years, as one third of it must be devoted to the ecological transition. This is an unprecedented exercise of solidarity that opens up new possibilities and benefits the countries most damaged by the crisis. However, despite its importance, there are still very significant challenges:

(1) It must be put into operation as soon as possible and for this to happen, all States will need to approve their recovery plans. The "slow machine" continues to be a handicap when compared to the more immediate reactions from other actors, such as the US. It is urgent to act now, so that the projects can be launched, and the funds can reach the business world and citizens as soon as possible;
(2) It is essential to ensure that the recovery fund is used effectively, without excessive bureaucracy but also without corrupt practices. Citizens will make judgements based on the results;
(3) The public debt that is currently soaring, especially in southern Europe, cannot be allowed to end up causing another sovereign debt crisis in the eurozone. It is also important to ensure that the recovery fund is used to restructure weaknesses in the economies mentioned above;
(4) The approved instrument is temporary: success in its implementation and in its results is the best way to guarantee that it can be extended beyond the recovery, with a consequent move towards greater fiscal union.

In addition to the above, the Union can also influence national public spending through its State aid control policy and contribute to promoting green co-financing and investments by private players.

In short, this is a huge challenge and a complex task for the Union. The approval of the 2021 European Climate Law was a crucial step in developing a better governance framework, since the EU objective of reaching climate neutrality in 2050 is now a binding legal target. However, its effective implementation will depend very much on the way the European institutions and the Member States act. In other words, only realistic strategies and the smartest combination of regulatory and economic instruments will ensure that the long-term targets are attained.

2.1 Key Legal Principles

The legal principles guiding environmental governance in the European Union have evolved significantly throughout the amendment of the founding treaties. Nowadays, apart from the specific EU environmental policy principles[5]—precaution, prevention and rectifying pollution at source, and PPP—additional legal principles and values have to be taken into consideration, as other EU policies are required to contribute to

[5] For the global dimension, see Eccleston (2011).

environmental protection under the EGD. Ensuring an effective EU internal market, for example, is at the heart of the EU process and, consequently, is also present in many of the tax directives. However, the rationale behind each piece of legislation in the EU is not always aligned with the EGD or compatible with other fundamental principles. Identifying and correcting the mismatches is also part of the EU agenda. For example, in the energy sector, the sustainability principle is more important now than others—e.g., security of energy supply—in the new packages of EU energy legislation. Another example could be EU competition policy. There is great scope for greening this policy, although there is some disagreement as to what extent this should be done (See Kingston 2011; Holmes et al. 2021). There is some room in antitrust and mergers law, but the scope and the impact of the reform of State aid control could be larger.[6] Why should this be so? As explained above, both European funds and national funds will play a very important role. Many of these national funds will fall under the concept of State Aid and be subject to the supervision of the European Commission. In 2018, 55% of spending on state aid—66.5 billion euros—was already for environmental and energy savings goals, a massive increase in comparison with the previous decade (only 2.4%), and yet this figure still needs to increase. Therefore, it is essential to properly design and update the European State aid control framework in order to create the right green incentives and conditions. As Commissioner Vestager has stated: "European governments will have to invest billions of euros in greening the economy – and our rules need to give them room to do that, while also making sure that we get the best results for the planet from the money that's spent".[7]

Apart from the climate strategic actions to achieve decarbonisation in the EU, one of the main building blocks of the EGD is the new circular economy action plan (CEAP).[8] This targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented, and the resources used are kept in the EU economy for as long as possible. As a result, according to the subsidiarity principle, legislative and non-legislative measures have been implemented targeting areas where action at the EU level brings real added value. Although no international policy effort integrates circular-economy approaches, circularity principles can play an important role in helping organisations to hedge against volatility in the prices of commodities. This is why the European Commission is proposing that the product sustainability principles should guide broader policy and legislative developments in the future. The CEAP encourages the broader application of well-designed economic instruments, such as environmental taxation, including landfill and incineration taxes, and enables Member States to use value added tax (VAT) rates to promote circular economy activities that target final consumers, in particular repair services. Environmental taxation could be a suitable instrument and the right policy option to reduce plastic pollution in the current environmental emergency. It can also provide the right signal to citizens, producers and industry to change behaviours and contribute to meeting the ambitious environmental targets. Taxes on single-use plastics for example (in the UK, Italy or Spain) are intended to have an environmental purpose but at the same time they can also pursue other goals, such as raising revenues to aid economic recovery.

The principle of national financing of environmental measures is included in the TFEU as an expression of solidarity within the fold of the EU. In this sense and without prejudice to the importance of certain measures adopted by the

[6] For a critical assessment before the reform, see Maillo (2017).

[7] M. Vestager, Keynote speech at the 25th IBA Competition Conference, 10 September 2021, available at https://ec.europa.eu/commission/commissioners/2019-2024/vestager/announcements/competition-policy-support-green-deal_en.

[8] European Commission (2020), A new Circular Economy Action Plan. For a cleaner and more competitive Europe. Brussels, 11 March 2020, (COM) 98, final.

Union, the Member States shall also finance and implement the environmental policy. This principle is accompanied by a rule that partially compensates the potential negative effects for national budgets: if a measure involves costs deemed disproportionate for the public authorities of a Member State, such measure shall lay down appropriate provisions in the form of temporary derogations, and/or financial support from the Cohesion Fund.[9] In particular, the EU Just Transition Fund is an important tool that provides conditional access to resources, with the aim of reaching climate neutrality objectives. At least 50% of co-national finance is required for the most advanced regions.

Currently, the EU financial support linked to *Next Generation EU* and the *2021-2027 EU budget* is the basic lever for all the national ecological transition processes. The EU's 2021–2027 long-term budget, together with the NextGenerationEU recovery instrument, amounts to €2.018 trillion in current prices. The package consists of the long-term budget, the 2021–2027 multiannual financial framework, made up of €1.211 trillion in current prices, combined with the temporary recovery instrument, NextGenerationEU, of €806.9 billion.[10]

2.2 The Question of Environmental, Energy and Tax Competences

In the EU, environmental competences are shared by the EU and its Member States.[11] Thus, the Union and the Member States may legislate and adopt legally binding acts in this area, covering, among other fields, air and water pollution, waste management and climate change.[12] According to the official reports, monitoring environmental actions has played an important part in the successes achieved. In May 2016, the 'Environmental Implementation Review'[13] proved to be an important tool for the full implementation of EU environmental legislation, alongside the 'Regulatory Fitness and Performance Programme' (REFIT) for reporting and monitoring obligations, which aimed to make these simpler and less costly. Moreover, in 2020, the European Environment Agency (EEA)[14] published its '6th State of the Environment Report' on the status and outlook of the European environment.[15] The assessment showed that "incremental changes have resulted in progress in some areas but not nearly enough to meet our long-term goals".[16] For example, with regard to pollutants released into the air, water and land, the European Pollutant Release and Transfer Register (E-PRTR) provided key environmental data from over 30,000 industrial facilities in the EU.

In the EU, national governments are free to decide how to exploit their energy resources, what mix of energy sources they prefer to rely on (with the exception of renewable energy for which national targets are settled at the EU level) and how they tax or subsidies energy. Taxes are a central aspect of national sovereignty, and most of the Member States have introduced taxes on energy products. Fiscal purposes are often combined with environmental objectives, such as stimulating a reduction in energy consumption and in greenhouse gas emissions into the atmosphere. These so-called 'environmental taxes' are frequently levied on certain types of emissions or

[9] See Article 192 (4) and (5) of the TFEU.

[10] See European Commission (2021a). More information on the recovery plan for Europe at: https://ec.europa.eu/info/strategy/recovery-plan-europe_en.

[11] See Articles 11 and 191 to 192 of the TEFU. Article 192 (1) of the TFEU states that "The European Parliament and the Council, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee and the Committee of the Regions, shall decide what action is to be taken by the Union in order to achieve the objectives referred to in Article 191".

[12] Article 2 (2) of the TFEU.

[13] Communication from the Commission *Delivering the benefits of EU environmental policies through a regular environmental implementation review*. Brussels, 27 May 2016 (COM (2019) 316 final.

[14] In 1990, the EEA, based in Copenhagen, was established to support the development, implementation and evaluation of environment policy and to inform the general public on the matter.

[15] https://www.eea.europa.eu/soer/2020.

[16] See Hans Bruyninckx, EEA Executive Director, *supra note* 18.

on the consumption of energy. However, different approaches to energy taxation may create obstacles to trade and some national regulations may come into conflict with EU law. As the establishment of the internal market is very close to the core of national tax sovereignty, most of the energy taxes are harmonised at EU level.

2.3 The Need to Promote an EU State Aid Framework Aligned to the EGD

One important concern for good tax and environmental governance is the expansion of EU competition policy to tax issues and its effective contribution to the environmental objectives. The EU State aid rules are currently the major constraint on the tax sovereignty of national legislators (See, among others, Schön 2016), mainly because the expansion of the notion of 'State aid' allows for a great intervention of the European Commission. If this is accepted, the question is whether the current approach to tax measures and their assessment in the environmental and climate areas are well balanced.

To answer this question, the two sides of tax incentives should be considered: on the one hand, any measure acting as an incentive is a useful tool to correct market failures, to support the national economy and to create new economic activities, and on the other hand, incentives can distort competition, result in significant costs for governments and facilitate the abuse of lobbies. The assessment of a tax incentive for environmental purposes for example in an EU State aid context will depend on the balancing test applied between two different aims: (i) to protect market integration; or (ii) to ensure competition. This general statement is also valid in the fiscal field.

Any aid must be checked objectively against the notion of Article 107(1) of the TFEU considering the well-known circumstances:[17] the existence of an undertaking, the imputability of the measure to the state, its financing through state resources, the granting of an advantage, the selectivity of the measure and its effect on competition and trade between Member States. With a view to contributing to an easier, more transparent and more consistent application of this notion across the European Union, the 2016 Commission Notice on the notion of State aid[18] clarifies the different constituent elements of the notion of State aid and reminds us that "the notion of State aid is an objective and legal concept defined directly by the Treaty".[19]

The debate in fiscal circles is focused around three overlapping concepts: the notion of 'advantage', the notion of 'selectivity' and the notion of 'discrimination'. While selectivity is clear when Member States adopt *ad hoc* positive measures benefiting one or more undertakings, the situation is usually less clear for fiscal aid. In such cases, the 'material selectivity' of the measures should normally be assessed by means of a three-step analysis.

First, the system of reference must be identified.[20] Second, it should be determined whether a given measure constitutes a derogation from that system insofar as it differentiates between economic operators who, considering the objectives intrinsic to the system, are in comparable factual and legal situations. This assessment of whether there has been a derogation allows a conclusion to be drawn as to whether

[17] Art. 107(1) TFEU states: "Save as otherwise provided in the Treaties, any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the internal market."

[18] *See* Commission Notice on the notion of State aid as referred to in Article 107(1) of the Treaty on the Functioning of the European Union, OJ C 262/1 (19 July 2016), available at Official Journal of the European Union (2016).

[19] *See* European Union (2016), at para. 5.

[20] The reference system constitutes the benchmark against which the selectivity of a measure is assessed. In the case of taxes, the reference system is based on elements such as the tax base, the taxable persons, the taxable event and the tax rates. For example, a reference system could be identified regarding the corporate income tax system. *See* 2016 Commission Notice, *supra* n. 22 at para. 134.

the measure is *prima facie* selective. If the measure in question does not constitute a derogation from the reference system, it is not selective. However, if it does, it is necessary to establish, in the third step of the test, whether the derogation is justified by the nature or general scheme of the (reference) system. If a *prima facie* selective measure is justified by the nature or general scheme of the system, it will not be considered selective and will, thus, fall outside the scope of Article 107(1) of the TFEU.[21]

Generally, Member States must notify the European Commission of any aid, in line with Article 108(3) of the TFEU. As the compatibility of aid for environmental protection is often directly evaluated under Article 107(3), the Commission guidelines are a source of great importance for legal certainty.

In this sense, the new guidelines on State aid for climate, environmental protection and energy[22] recognised that "competition policy, and State aid rules in particular, has an important role to play in enabling and supporting the Union in fulfilling its Green Deal policy objectives. The European Green Deal Communication specifically states that the State aid rules will be revised to take into account those policy objectives, to support a cost-effective and just transition to climate neutrality, and to facilitate the phasing out of fossil fuels, while at the same time ensuring a level-playing field in the internal market".[23] These new guidelines reflect that revision in section 4.7, dedicated to "aid in the form of reductions in environmental taxes and parafiscal levies". Still, as laid down in previous guidelines, when environmental taxes are harmonised, the Commission may apply a simplified approach to assess the necessity and proportionality of the aid. In the context of Directive 2003/96/EC (the so-called Energy Taxation Directive, ETD) the Commission may apply a simplified approach for tax reductions respecting the Union minimum tax level.

Finally, a brief reference to the flexibilisation of these measures is considered. The outbreak of the novel COVID-19 virus has had a significant economic impact. The various containment measures adopted by the Member States, such as travel restrictions, quarantines and lockdowns, hit the cultural, entertainment and tourism sectors particularly hard. On 19 March 2020, the European Commission adopted a Temporary Framework to enable Member States to use the full flexibility provided for under State aid rules to support their economy and help overcome the extremely difficult situation triggered by the COVID-19 outbreak. This Temporary Framework, in place until the end of June 2022, is based on Article 107(3)(b) of the TFEU and complements other possibilities available to Member States, in particular the possibility under Article 107(2)(b) of the TFEU to compensate specific companies or specific sectors for the damage directly caused by exceptional occurrences, such as the virus outbreak. Amendments were adopted on 3 April, 8 May, 29 June and 13 October 2020, and on 28 January and 18 November 2021, extending the scope of

[21] *See* id., at para. 128. *See also* NL: ECJ, 8 Sept. 2011, Case C-279/08 P *Commission v. Netherlands*, para. 62; AT: ECJ, 8 Nov. 2001, Case C-143/99, *Adria-Wien Pipeline GmbH and Wietersdorfer & Peggauer Zementwerke GmbH v. Finanzlandesdirektion für Kärnten*, Case Law IBFD; IT: ECJ, 8 Sept. 2011, Joined Cases C-78/08 to C-80/08, *Amministrazione delle Finanze, Agenzia delle Entrate v. Paint Graphos Scarl; Adige Carni Scrl, in liquidation v. Ministero dell' Economia e delle Finanze, Agenzia delle Entrate; Ministero delle Finanze v. Michele Franchetto*, para. 49 et seq., Case Law IBFD; and UK: ECJ, 29 Apr. 2004, Case C-308/01, *Gil Insurance Ltd and Others v. Commissioners of Customs & Excise*, Case Law IBFD.

[22] The new guidelines, applicable from January 2022, create a flexible, fit-for-purpose enabling framework to help Member States provide the necessary support to reach the Green Deal objectives in a targeted and cost-effective manner. European Commission (2021), Annexes to the Communication to the Commission. Approval of the content of a draft for a Communication from the Commission on the Guidelines on State aid for climate, environmental protection and energy. Brussels, 21 December 2021 (C(2021) 9817 final, https://ec.europa.eu/competition-policy/system/files/2021-12/CEEAG_Guidelines_with_annexes_I_and_II_0.pdf.

[23] Paragraph 4 of the new guidelines, *supra n.* 26.

the Temporary Framework.[24] The Temporary Framework allows for a more simplified approach to help green investments with public financial support, and has led to an increased use of the approved COVID-19 measures. Although the flexibility created under the temporary State aid regime, as well as the determined action of the European Central Bank, have created space for national action to prevent the collapse of the economy and to protect businesses, jobs and livelihoods, large differences in the amount of State aid given by EU Member States have the potential to create an unlevel playing field inside the European Union.

3 Environmental Taxes: Tax Harmonisation and the ETR

There is general scepticism over whether important societal values—such as protecting the environment—can be achieved through the tax system (Barker 2005). Nevertheless, the role of regulatory taxes has been strengthened in recent years because environmental challenges and tax law are closely related topics. The crucial role of taxes in achieving net zero carbon emissions is widely recognised in economics literature. In particular, the so-called 'environmental taxes' seek to provide the right price signals to the market and to promote changes in the national tax systems. In this sense, the UN 2030 Sustainable Development Agenda clearly indicates that taxes are to play a key role in the implementation of the seventeen regulatory goals—referred to as the 'Sustainable Development Goals' (SDGs)—included in it. These goals are broad and ambitious, ranging from ending poverty (SDG 1) to ensuring access to affordable and sustainable energy (SDG 7) and achieving gender equality (SDG 5). Besides the EU and the OECD, it is striking to note that the United Nations also perceives tax measures "as regulatory and as coordination instruments to achieve its 2030 Agenda" (See Dourado and Pirlot 2020).

Climate change is one of the most urgent challenges that the international community currently faces. Based on the calculations of the European Commission, the costs of air pollution, GHGs and water pollution alone amount to at least €750 billion per year across the EU (European Commission 2021b). A broad range of policy instruments can be used to curb carbon emissions. Economic instruments, in particular taxes and emissions trading, are vital tools for any comprehensive mitigation strategy to operationalise the PPP in an effective way.

However, as the European Court of Auditors has confirmed, many opportunities for a more rigorous application of the PPP in the EU have still been missed (European Court of Auditors 2021). In comparison with other existing alternatives (e.g., EU ETS), environmental taxes have additional advantages: (i) easier implementation; (ii) less bureaucracy; and (iii) the possibility of using tax revenue to the best public interest (See Bretschger and Smulders 2012; Bowen 2015; Steenkamp 2021).

As we have remarked in other contributions, environmental and energy issues intersect in a particularly strong way in the policy area of climate change, given the need to reduce emissions from fossil fuels and shift to clean energy practices. Precisely in this context, it is important to clarify the impact of tax benefits on the energy sector, the design of the European and international laws and the constraints these impose on tax authorities wishing to promote environmental protection. Yet, it may be difficult to reconcile undistorted trade with clean energy objectives. Indeed, governmental policy instruments that promote clean practices can distort market competition at the international, national or sub-national level. For example, they may intervene in the market by providing subsidies or tax benefits to encourage renewable energy and energy conservation or to protect industries at risk during the transition to a greener economy. This is why the integration of EU State aid policy

[24] A consolidated version of the Temporary Framework as adopted on 19 March 2020 and its amendments is available at https://ec.europa.eu/competition-policy/system/files/2021-11/TF_consolidated_version_amended_18_nov_2021_en_2.pdf (accessed 29 Dec 2021). The authentic versions of the Temporary Framework are those published in the Official Journal of the European Union.

and tax policy is of great importance in the field of energy taxation. Moreover, the Commission's revision of State aid rules mentioned in section 2.3 is a priority, as regards action taken to facilitate investments, to allow for targeted interventions to facilitate energy and environmental investments, ensuring a level playing field and respecting the integrity of the single market (See Villar Ezcurra 2017, p. 38).

One of the problems with improving the EU legislation on energy taxation is that there is no common understanding of what exactly constitutes an environmental tax. Frequently, economists adopt a broad understanding, and the expression 'carbon taxes' is deemed to refer to the idea of putting prices at the right level considering environmental externalities. In contrast, a narrow concept is included in regulations and also defined in several judgments at national or European level. However, one common characteristic is that environmental taxation serves to encourage ecological behaviour by taxing bad behaviour and promoting good behaviour. Moreover, in the theory of environmental tax reform (ETR) so-called 'Pigouvian taxes' are conceived as figures created with the aim of allowing a transformation of national tax systems. In the theory's original framework, the new resources were supposed to allow a reduction of the fiscal pressure on income from labour. However, as experience shows, the recent ETR waves all over the world no longer pursue a 'double dividend' (financial and environmental dividend) but rather put in place new legal packages including financial measures to support vulnerable situations. Therefore, the possible distributional effects of environmental tax reforms and the role of taxation to mitigate climate change should be highlighted.

In the European Union, the ETS and the ETD are complementary economic instruments that set carbon pricing. As carbon pricing instruments, they are also often thought to lead to carbon leakage and a loss of competitiveness for domestic enterprises.

On the one hand, the EU ETS is a market-based instrument, which generates revenues for Member States. Today, this mechanism applies to the power generation and industrial sectors, as well as aviation within Europe. With the 'Fit for 55' package, it will be progressively extended to the maritime sector, and, gradually, by 2026 all aviation allowances will be auctioned. Moreover, the revision of the Emissions Trading Directive foresees a new Emissions Trading System covering road transport and buildings.

On the other hand, the taxation of energy products and electricity plays an important role in the area of climate and energy policy. Therefore, harmonised rules set out under Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity (Energy Taxation Directive, ETD) could play a key role. The aim of such rules is to ensure the proper functioning of the internal market. Since the ETD was adopted, the underlying climate and energy policy framework has radically changed, and the Directive is no longer aligned with current EU policies.

The EU energy taxation framework was evaluated in 2019 and it was considered that energy taxation can play an important role as one of the economic incentives that steer successful energy transition, driving low greenhouse gas emissions and energy savings investments while contributing to sustainable growth. Accordingly, the Council of the European Union invited the Commission to revise the ETD. Moreover, it became clear, as stated in the Explanatory Memorandum of the proposal to recast the Directive,[25] that the ETD is not in line with EU climate and energy objectives because it does not adequately promote greenhouse gas emissions reductions, energy efficiency and the take-up of electricity and alternative fuels (renewable hydrogen, synthetic fuels, advanced biofuels, etc.) and does not provide sufficient incentives for investments in clean technologies. Besides, the ETD *de facto* favours fossil fuel use. Highly divergent national rates are applied in combination with a wide

[25] COM(2021) 563 final. The explanatory memorandum is available at: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52021PC0563.

range of tax exemptions and reductions which are not aligned with the objectives of the EGD. Finally, the ETD is no longer contributing to the proper functioning of the internal market as the minimum tax rates have lost their converging effect on national tax rates. Minimum rates are low as they have not been updated since 2003, although national rates are significantly above the ETD minima in most cases. In any case, the ETD minima therefore no longer prevent a "race to the bottom" nor constitute a floor for taxation. All this, added to the existence of exemptions and reductions, increases the fragmentation of the internal market and in particular distorts the level playing field across the involved sectors of the economy. In addition, there are some aspects of the ETD that lack clarity, relevance and coherence, which creates legal uncertainty. These include, among others, the definition of taxable products and uses that are outside the scope of the Directive and the interpretation of the exemption related to motor fuels used in air and waterborne navigation.

The main changes included in the proposal for a revised Directive[26] addressed these problems with the following measures: (i) Fuels will start being taxed according to their energy content and environmental performance rather than their volume. In this way, the environmental impact of individual fuels will be better reflected, helping businesses and consumers alike to make cleaner, more climate-friendly choices; (ii) the way in which energy products are categorised for taxation purposes is simplified to ensure that fuels most harmful to the environment are taxed the most; (iii) exemptions for certain products and home heating will be phased out, so that fossil fuels can no longer be taxed below minimum rates and (iv) fossil fuels used as fuel for intra-EU air transport, maritime transport and fishing should no longer be fully exempt from energy taxation in the EU—a crucial measure given the role of these sectors in energy consumption and pollution.

[26] COM(2021) 563 final.

4 The Core of the EU Green Deal: Towards a Fair and Green Tax Framework

A multidisciplinary and holistic approach is provided by the 2021 Fit for 55 legislation package presented by the European Commission in order to support its commitment to reduce net GGE by at least 55 per cent by 2030. The package represents a new policy action plan on how to reach Europe's climate targets, in line with its ambition to become the first climate-neutral continent by 2050.

4.1 The Fit for 55 Legislative Package

The proposal specifically aims to (i) include emissions from maritime transport in the EU ETS; (ii) phase out free allocation of emission allowances to aviation and to the sectors that are to be covered by the *carbon border adjustment mechanism* (CBAM);[27] (iii) implement the global carbon offsetting and reduction scheme for international aviation (CORSIA) through the EU ETS; (iv) increase funding available from the modernisation fund and the innovation fund and (v) revise the market stability reserve in order to continue ensuring a stable and well-functioning EU ETS.

Within the Council, proposals are dealt with in four Council formations: Environment, Energy, Transport, and Economic and Financial Affairs. Most of the discussions in the Council have highlighted the strong interlinkages between the proposed ETS for buildings and road transport and other elements of the Fit for 55 package, particularly the Social Climate Fund Regulation, the Effort Sharing Regulation, the Energy

[27] See European Commission, 'Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism (EU CBAM proposal)' COM (2021) 564 final. See also Commission, 'Delivering the European Green Deal' (14 July 2020). https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.

Taxation Directive, the Regulation on CO_2 emission standards for cars and vans, and the Energy Efficiency Directive. The Presidency's assessment[28] was that considerable further technical work will be required on most of the files due to their complexity and the introduction of new elements, and additionally, as regards the ETS, the sheer size of the file. Three proposals are dealt with under ETS reform:[29] a proposal to amend the ETS Directive, the Market Stability Reserve (MSR) Decision and the MRV shipping Regulation ("general ETS"), a proposal to amend the ETS Directive as concerns aviation ("ETS aviation") and a separate proposal to amend the MSR Decision.

The ETS is at the heart of the EU's climate policy. While there appears to be general acknowledgement that the ETS will have to deliver its cost-efficient share of the EU's increased ambition, views differ on the proposed changes. In this context, there have been some calls for exploring options to further increase the ambition of the ETS but also concerns about possible impacts of certain parts of the proposals on both economic sectors and households, underlining the need to consider the different situations of Member States. More clarification will be needed for (i) the establishment of a separate ETS for buildings and road transport and (ii) the strengthening of the existing ETS and its ambition.

Particular attention has been given to the proposed phase-out of free allocation in the ETS for sectors covered by the carbon border adjustment measures (CBAMs). Traditionally, CBAM are described as regulatory instruments that can be used to mitigate climate change, but which also have a positive impact on trade, climate leadership and even public finance. The objective of the Commission's proposal on CBAM is to prevent the EU's emissions reduction efforts from being offset by increasing emissions outside its borders through relocation of production to non-EU countries (where polices applied to fight climate change are less ambitious than those of the EU) or increased imports of carbon-intensive products. Many questions have been posed on the impact of the phase-out on EU producers' competitiveness in export markets.

If adopted, the EU CBAMs would require importers of certain energy-intensive products (such as cement, iron and steel, aluminium, fertilizers and electricity) to pay a carbon price equivalent to the price imposed in the EU through the EU ETS as of January 2026. As Pirlot suggested "they can serve as straightforward multi-purpose instruments" and "the design of the EU CBAM is inconsistent with the Commission's main objectives of promoting fair competition and climate mitigation in line with the Paris Agreement" because the EU CBAM proposal is primarily an instrument of climate leadership (See Pirlot 2021).

4.2 New Resources for the EU Budget

To better support the objectives of Union policies and to reduce Member States' contributions based on gross national income to the Union's annual budget, the European Council held in July 2020 concluded that the Union will work in the coming years to reform the own resources system and introduce new own resources.

[28] See Council of the EU, Brussels, 6 December 2021 (14585/21). https://data.consilium.europa.eu/doc/document/ST-14585-2021-INIT/en/pdf.

[29] Proposal for a Directive amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757 (do. 10875/21 + ADD 1-7); Proposal for a Directive amending Directive 2003/87/EC as regards aviation's contribution to the Union's economy-wide emission reduction target and appropriately implementing a global market-based measure (doc. 10917/21 + ADD 1-3); Proposal for a Decision amending Decision (EU) 2015/1814 as regards the amount of allowances to be placed in the market stability reserve for the Union greenhouse gas emission trading scheme until 2030 (doc. 10902/21 + ADD 1). In addition, a fourth proposal concerning ETS was submitted on 14 July 2021: Proposal for a Decision amending Directive 2003/87/EC as regards the notification of offsetting in respect of a global market-based measure for aircraft operators based in the Union. The proposal is dealt with separately under TTE (Transport).

As a first step, a new category of own resources based on national contributions calculated on the basis of non-recycled plastic packaging waste was introduced in December 2020 in order to ensure the financing of the European Union's annual budget.[30] At the same time, Member States are free to take the most suitable measures to achieve goals related to the reduction of plastic packaging waste, in line with the principle of subsidiarity. This new resource to finance the EU budget has been in force since January 2021. It is a national contribution based on the amount of non-recycled plastic packaging waste. Member States will apply a uniform rate of €0.80 on the amount of plastic resulting from the difference between what was produced and what was recycled; a mechanism that will prevent excessive contributions from less wealthy Member States will accompany this contribution. The principal aims of this plastic measure are to encourage Member States to reduce the consumption of single-use plastic products, promote recycling and boost the circular economy. It is important to stress that the EU levy is not a tax and the European regulations neither recommend nor require Member States to introduce a tax.

The European Commission has proposed as a second step an amendment of the Own Resources Decision to introduce three new categories of own resources based on: (i) the CBTAM; (ii) the revised EU ETS and (iii) a share of the residual profits of the largest and most profitable multinational enterprises that are allocated to EU Member States following the agreement by OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting to address the Tax Challenges Arising from the Digitalization of the Economy (*OECD/G20 Inclusive Framework Agreement*). These revenues will be used for both the repayment of *Next Generation EU* and the financing of the Social Climate Fund.[31] This proposal is consistent with and complementary to the Fit for 55 package.

5 Conclusion

In the EU, the future challenges associated with green economic recovery cannot be tackled without fiscal tools. It is urgent to review the directive on energy taxation as well as to extend the trading of emission rights to the maritime and air transport sector because the polluter pays principle is not sufficiently reflected in European Union Law, as the European Court of Auditors has stated, and as is manifest in its reports.

For the ambitious strategy of the European green deal to be truly successful, governance must be strengthened, especially in the areas of environment, energy and taxation, because it is necessary to mobilise investments and plan infrastructures and interconnections. The intersection between fiscal and competition policy (above all State Aid Law) can also play a very important role in fostering the right green investments, both from Member States and private actors.

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[30] Council Decision 2020/2053 of 14 December 2020 on the system of own resources of the EU and repealing Decision 2014/335/EU.

[31] https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_7026.

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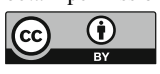

Legal and Normative Challenges Behind Sustainable Seafood

Josephine Woronoff

Abstract

In the last decades, governments and international governmental organisations have been harshly criticised for their perceived failure to mitigate the environmental and social impacts of seafood production in a sustainable manner. In the 1990s, civil society stepped in, and public regulations were challenged by market-based initiatives. Since then, the sustainable seafood movement has seen a major acceleration with new initiatives having enormous impacts on the evolution of fisheries management worldwide. Today, norms, principles and standards are competing with and/or complementing each other in their attempt to integrate sustainability into the seafood sector. This chapter will present the global normative framework surrounding the concept of sustainability in captured seafood. It will analyse how all layers of norms interact with each other. Analysing these interactions will help understand the respective roles that these local, private and public initiatives are playing for each other in order to keep improving sustainability.

Keywords

Ocean governance · Law of the sea · Sustainable seafood

1 Introduction

Food sustainability is one of the greatest challenges of the century (United Nations General Assembly (UNGA) 2015). With human population expected to grow to 9.6 billion by 2050, food production will increase accordingly (European Environment Agency (EEA) 2016, p. 9). However, the current trajectory of our global food system is bleak. It is responsible for 60% of terrestrial biodiversity loss, 24% of greenhouse gas emissions, and 33% of soil degradation, as well as its contribution to inequality (United Nations Environment Programme (UNEP) 2016, pp. 14–16). The fisheries sector is no exception. Fish consumption is increasing at twice the rate of annual world population growth and over a third of stocks are fished at biologically unsustainable levels (Food and Agriculture Organization of the United Nations (FAO) 2020). Fishing is essential for millions of coastal communities, for food security, livelihood and cultural heritage, particularly in developing countries and in a context of climate change (FAO 2020). Ensuring sustainability in the seafood sector is essential.

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Taking a closer look, we can see that many regulations and norms have already been created by different actors, all aiming to bring sustainability to the fisheries sector. Local and indigenous communities have been self-managing their harvest for millennia, through beliefs, religion and customs, creating a first layer of norms (1). Then, governments received mandates to legislate, from the global to the local level and international organisations published codes of conduct, guidelines and statements to guide them (2). Less than 50 years ago, civil society and non-governmental organisations (NGOs) began developing their own standards, benchmarks and toolkits, and these were soon followed by global companies setting up, in partnerships and collaborations, their own internal policies on sustainability (3). Each of these layers have created norms that currently compete, complement or replace each other and influence actors' behaviours (Parlee and Wiber 2014). This chapter seeks to provide a broad overview of the current state of global norms influencing the sustainability of the seafood sector. Taking a global and historical approach allows this analysis to more accurately frame a complex normative system that goes beyond the traditional view of a world only governed by top-down command-and-control legal rules (van Erp et al. 2019, p. 4). Finding a way to preserve the oceans' resources while protecting the people that depend on them, is very complex, and calls for the development of sustainable avenues at all levels.

2 Ancient Fisheries Management: Local Community Arrangements for Self-Regulation

Fishing is one of the most ancient productive activities that still feeds human populations on a large scale. It appeared soon after the birth of humankind, long before agriculture. Indeed, hunter-gatherers were also fishers. In all parts of the globe, researchers have reported many examples (Johannes 1978; Berkes 1985; Colding and Folke 2001; Nunoo et al. 2015) of populations self-regulating their harvest of natural resources. In ancient China, there are traces of fisheries management as far back as 5000 years ago, with rulers showing constant enthusiasm for sustainable use of fisheries resources (Li et al. 2010). Following the Yellow Emperor, Emperor Ku called on his tribe "to exploit natural products moderately and utilize them frugally".[1] Historical traces have been found of local implementation of bans on fishing young or pregnant aquatic animals, on unseasonable fishing, on poisoning aquatic animals, on damaging waters, and on over-fishing (Li et al. 2010, p. 42).

China is one of the many examples of fisheries management. In most other coastal areas around the globe, questions of access to and sustainable uses of ocean resources have been worked out within and between fishing communities for thousands of years.[2] A flourishing diversity of norms were designed and imposed using different means such as local regulatory systems, customs, religions, taboos and beliefs to ensure a 'sustainable' management system. Norms were adapted to local specificities, often using a bottom-up approach. Fishing mainly for subsistence, the collective interests of the community often encouraged norms in favour of resource conservation, limiting fisheries' access rights and regulating fishing efforts, even though "conscious conservation [was] often absent or in the background" (Berkes 1985, p. 204). In ancient China, though, the will to conserve natural resources was a declared priority. More than 2000 years ago, it was recorded in Guan zi:

> Though water areas are immense and water animals are numerous, meshes of fishing nets must be under meticulous supervision. Fishing nets can absolutely not be of one format. It isn't because we are partial to water animals. We are afraid that our wrong doings will whittle away the subsistence roots for generations of people.[3]

This contrasts dramatically with what would be said more than 2000 years later, in 1883, by the biologist Thomas Huxley in his opening address

[1] Li et al. (2010, p. 36) citing Wu Di Ben Ji in Shi Ji.

[2] For more examples, see Berkes (1985).

[3] Li et al. (2010, p. 41), citing Ba Guan in Guan Zi.

to the International Fisheries Exhibition in London: "I believe, then, that the cod fishery… and probably all the great sea fisheries, are inexhaustible: that is to say that nothing we do seriously affects the number of fish. And any attempt to regulate these fisheries seems… to be useless."[4] A century later, the dramatic collapse of the cod fishery would lend credibility to the ancient Chinese wisdom of frugality. In between is the history of a different layer of norms that grew and ultimately overshadowed the old one, building the foundation for the current international regime of the law of the sea.

The ancient layer of self-regulating arrangements is, however, still present today. A recent rise can even be observed. Indeed, an increasing number of small-scale fisheries communities all over the globe are setting up community-based resource management systems, self-regulating and self-controlling both access to the resource and fishing practice "based on a wide array of justifications related to social cohesion, religion or management guidelines based on local ecological knowledge" (Bush and Oosterveer 2019, p. 29). The state is very often present in the arrangement with varying degrees of involvement, creating a large diversity of co-management arrangements from a legal perspective (Environmental Law Institute 2020). However, recognition of such arrangements as part of the concept of sustainability in seafood is still a work in progress. Despite some essential moves from global actors (the 2015 FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication) (FAO 2020), the dominant layers of norms related to seafood sustainability are more focused on the industrial fishing sector and the sovereignty of the State. To better understand the dominant norms, it is important to go back in time and highlight how these normative layers emerged.

[4] Allison (2001) citing Thomas Huxley's opening address to the International Fisheries Exhibition, London (Whymper 1883).

3 Historical Perspective on the International Regime of the Law of the Sea

The second layer of norms first took root and developed in Europe, laying the foundations for our current international law of the sea (Treves 2015). Here, the question of sustainability and conservation would come much later. Indeed, the idea of the ocean being inexhaustible dominated until the twentieth century. The development of our current legal regime was predominantly, and for a long time, based on the issue of access rights (Allison 2001, p. 937), organised around the debate between national sovereignty and freedom at sea.

In the Roman Empire, the sea was 'a common right to all men', as long as they were Roman citizens (Allison 2001). This established the doctrine of *mare clausum*, a closed sea not accessible to other nations. After the collapse of the Roman empire, new states appeared and appropriated areas of sea as *mare clausum*, defending them against piracy and leveraging taxes for passing trade routes (Zacharias 2014). This culminated, in 1494, with the Treaty of Tordesillas, which, following an imaginary line going from pole to pole, 370 leagues from Cape Verde and the Azores, gave all territories discovered and to be discovered west of this line to Spain and east to Portugal (Treves 2015, p. 3). With the imaginary line drawn on the ocean, this represents "the most ambitious claim to sovereignty over the sea" (Treves 2015). This treaty, however, was quickly challenged by other trading nations, including the Netherlands. A 'battle of the books' in the seventeenth century led to the establishment of a new doctrine, for freedom of the high seas. This new doctrine of *mare liberum* was described by the Dutch jurist Hugo de Groot (Grotius) in the seventeenth century, arguing that because the ocean could not be 'occupied' or defended in the same way as land, it should be, like the air, common property of all (Grotius 1916, p. 28). However, coastal states would keep jurisdiction over a narrow band along their coastline as territorial waters (or *mare clausum*). This narrow band was first

calculated to be 3 nautical miles (NM), corresponding to the distance a cannon ball could be fired from the coast, making it defendable (Treves 2015, p. 5). Over time, more states adopted and applied this arrangement. It became one of the first recognised principles of international marine law. Thus, under this newly recognised regime, coastal states' citizens would have open-access rights to harvest fish within their own country's jurisdiction, as well as open-access to fish in the high sea, this time shared with all from any nation (Allison 2001, p. 937). For a long time, this system operated side by side with the ancient customary arrangements of communities that largely remained responsible for fisheries management.

After the industrial revolution, with the invention of steam powered boats and the development of technology, the capacity to catch fish increased dramatically. The development of industrial fishing, the general globalisation of the world, the erosion of community control over resources, rapid commercialisation, population growth, and the development of technologies brought massive changes to the fishing sector (Berkes 1985, p. 204). The perspective on fish evolved from it being a source of subsistence food to it being a commodity product with potential economic benefits. Fish stocks began to deplete, forcing fishermen to go further asea, away from their local coastlines, quickly creating conflict with neighbouring coastal countries.[5] From freedom at sea, coastal states became more inclined to expand and regulate their territorial waters. They first passed regulations to restrict who could fish within their seas, in order to protect national fleets against the invasion of foreign fishing fleets.[6] However, as fish stocks continued to deplete, governments moved towards regulating their fisheries in order to reduce the number of fish taken from the sea in an attempt to avoid collapse of stocks. Facing the growing number of national regulations on fisheries, communities' customary arrangements already in place for managing fisheries began to be eroded, undermining a "local sense of ownership and responsibility for the stewardship of these fisheries resources" (Bush and Oosterveer 2019, p. 78).

A global approach was called for. International negotiations took more than half a century (Churchill 2015) and concluded with the adoption of the United Nations Convention on the Law of the Sea (UNCLOS), in 1982.[7] Frequently referred to as the 'constitution for the oceans' Churchill (2015, pp. 24–25), UNCLOS, with its 320 articles and 9 annexes, can be considered a framework treaty (Long and Chaves 2015). In its wake, international instruments related to fisheries proliferated, implementing and updating it. The following are legally binding:

- The 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement);[8]
- The 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA);[9]
- The 2009 Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (PSMA) (FAO 2009):

[5] *Fisheries Case (UK v Norway)* [1951] ICJ Rep 116; *Fisheries Jurisdiction Case (UK v Iceland)* [1974] ICJ Rep 3; *Fisheries Jurisdiction Case (Germany v Iceland)* [1974] ICJ Rep 175.

[6] See for example the case of Pacific Halibut in Thompson and Freeman (1930, p. 44).

[7] United Nations Convention on the Law of the Sea (adopted 10 December 1982, entered into force 16 November 1994) 1833 UNTS 3.

[8] Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (adopted 24 November 1993, entered into force 24 April 2003) 2221 UNTS 91.

[9] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (adopted 4 August 1995, entered into force 11 December 2001) 2167 UNTS 3.

These international instruments set up principles and general norms that should be applied for the use of natural resources and conservation of the marine environment.

4 Nationalisation of Fisheries Management and Technical Fishery Policies

The first important principle confirmed by UNCLOS is the extension of coastal state jurisdiction over a territorialised sea of up to 12NM and an Exclusive Economic Zone (EEZ) of up to 200NM from baseline (Article 55 UNCLOS). According to Hoel et al., this represented "one of the most far-reaching institutional changes in the international society of the twentieth century" (Hoel et al. 2005). It would bring the vast majority of the world's fisheries under national authorities (UNGA 2004), including over 90% of fish stocks with commercial importance (Barnes 2006). Secondly, Article 55 UNCLOS gave sovereign rights to the coastal state 'for the purpose of exploring and exploiting, conserving and managing the natural resources' in its EEZ. These rights are predominantly economic, illustrating the shift towards fish as a commodity (Berkes 1985). Article 56 (b) (iii) added some jurisdictional power for the protection and preservation of the marine environment (Edeson 2005). A third principle relates to the 'sustainable use' of the resource. UNCLOS requires states to "ensure through proper conservation and management measures that the maintenance of the living resources in the EEZ is not endangered by overexploitation" (Article 61 (2) UNCLOS). Wide discretion is given to the coastal state to determine the meaning of 'proper' (Markowski 2009).

Article 61(3) UNCLOS, however, requires that proper conservation and management measures be "designed to maintain or restore populations of harvested species at levels which can produce maximum sustainable yield [(MSY)]". The concept of MSY is not defined by UNCLOS but can be "generally defined as the largest annual catch or yield of a fishery that can be taken continuously from the stock, based on the renewability of the resource" (Christie 1999). To maintain MSY, Article 61(1) requires the coastal state to determine the 'total allowable catch' (TAC) for the living resources. The state has discretion in the determination of its TAC (Article 297 (3)(a) UNCLOS). However, it has to follow the precautionary approach, another important concept that appeared after UNCLOS. Indeed, following the difficulties encountered with the concept of MSY, the precautionary approach would quickly receive wide acceptance after its introduction as Principle 15 of the Rio Declaration of 1992, which states "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (UNGA 1992). This principle was also explicitly incorporated by the UNFSA and the FAO Code of Conduct for Responsible Fisheries (FAO 1995).

Concerning species that move beyond and between different national jurisdictions, countries have a duty to cooperate in their conservation and management. This shared responsibility led to the establishment of Regional Fisheries Management Organisations (RFMO). The UNFSA laid the foundation for the creation of RFMOs responsible for managing the ocean resources outside the EEZ. Today, there are over 100 multilateral, regional and bilateral treaties, 14 UN agencies, and 19 international governmental organisations that have protection of the ocean as part of their responsibilities (Bush and Oosterveer 2019, p. 13). The UNFSA further requires states to adopt "measures to ensure long-term sustainability" of the shared stocks and "promote the objective of their optimum utilization" (Article 5(a) UNFSA). However, they must ensure that these measures "are designed to maintain or restore stocks at levels capable of producing maximum sustainable yield, as qualified by relevant environmental and economic factors, including the special requirements of developing states, and taking into account fishing patterns, the interdependence of stocks and any generally recommended international minimum standards,

whether subregional, regional or global" (Article 5 (b) UNFSA).

All these principles and concepts have been further added to by numerous non-binding instruments, often called 'soft law' (Allison 2001, p. 941). These are voluntary instruments that require national legislation to translate the commitments:

- FAO Code of Conduct for Responsible Fisheries;
- FAO International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU);
- FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas (Deep-sea Fisheries Guidelines);
- FAO International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks);
- FAO International Plan of Action for the Management of Fishing Capacity (IPOA-Capacity);
- FAO Voluntary Guidelines for Flag State Performance (Flag State Guidelines);
- FAO International Guidelines on Bycatch Management and Reduction of Discards (Bycatch Guidelines);
- FAO Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines);
- FAO Voluntary Guidelines on the Marking of Fishing Gears;
- FAO Voluntary Guidelines for Catch Documentation Scheme;
- Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem;
- CITES Resolutions relevant for international trade in CITES-listed commercially-exploited aquatic species, such as those resolutions concerning introduction from the sea, non-detriment findings and legal acquisition findings (CITES Resolutions); and
- United Nations General Assembly Resolutions (UNGA Resolutions) in particular those relating to oceans and the law of the sea and fisheries (COFI 2020).

The fisheries management regime established under UNCLOS ultimately leaves the responsibility of implementing and enforcing fisheries management rules in the hands of national governments, for both EEZ and the high seas. Very few means to sanction were included, leaving states largely free to implement the rules as they see best (Allison 2001, p. 938). National and regional fisheries regulatory systems generally use the optimum harvest model as a basis for management. From here, regulations take the shape of technical measures informed by scientific knowledge (Bush and Oosterveer 2019, p. 79). These technical measures are naturally restrictive and aimed at controlling input or output dimensions of the fishing activity. Bellido et al have suggested a clarification in the classification of these technical measures, which is presented below (Bellido et al. 2020).

Input measures seek to limit fishing efforts and can be divided into two sub-categories:

- *Regulation of fleet characteristics and technical gear characteristics*. Addressing the "how?", these regulations can limit the efficiency of gears and vessels by regulating technical and operational characteristics (length and engine power for vessels, design for fishing gear) (Bellido et al. 2020).
- *Regulation of fleet access to fishing grounds.* Answering the question "who, when and where?", this can restrict the number of fishing vessels allowed in the fishery (through licensing) and can also bring temporal restrictions by controlling fishing time (by day or week) or by setting up fishing seasons, as well as spatial restrictions setting up specific areas open or closed to certain fishing activities (Bellido et al. 2020).

Output measures concentrate on the question "What and how much?":

- *Regulation of what can be caught and what can be retained on board.* This includes regulation on the composition of the catch (permitted, vulnerable and prohibited species) and regulation on commercial minimum size and quotas and catch limits (TAC) (Bellido et al. 2020).

These top-down command-and-control regulations present many challenges. The correct application of the optimum utilisation model requires extensive scientific knowledge and technical expertise (Allison 2001, p. 940). Indeed, the MSY and TAC system relies on stock assessments that require advanced numerical modelling skills and precise data. In 2020, only 25% of the global catch was from numerically assessed stocks. For data-limited and capacity-poor fisheries, assessing stocks proves extremely challenging (FAO 2020). Moreover, it also requires heavy technological capacity for control and enforcement, which most countries lack. This lack of scientific information, enforcement capacity, and even political will led several iconic fisheries to their decline, raising concerns in civil society about the capacity of governments to redress the situation (Allison 2001, p. 940). Even developed states were criticised for their failure to manage their own fisheries (Birnie and Boyle 2002; Christie 2006). This drove civil society to intervene, beginning what would eventually be called the sustainable seafood movement, and developing a third level of norms (Roheim et al. 2018).

5 The Sustainable Seafood Movement and the Audit Culture Era

The sustainable seafood movement began in the 1970s mainly in the US and the EU. For nearly three decades NGOs campaigned before states and raised public awareness around specific issues related to the depletion of fish stocks and other iconic species, encouraging consumers to make informed choices when buying seafood. Campaigns and boycotts were the main tools used by NGOs to pursue their goals (Bush and Oosterveer 2019, pp. 106–106). In the 1990s, following high-profile cases such as the collapse of the cod stocks in the North Atlantic, the large-scale killing of dolphins by tuna purse seiners in the Eastern Pacific and illegal fishing of Chilean seabass in the South Pacific, the sustainable seafood movement took an important turn (Bush and Oosterveer 2019). Pushed by the perceived failures of governments to adequately and sustainably manage fisheries, civil society decided to step in (Bush and Oosterveer 2019, p. 108). US-based family philanthropic foundations, NGOs and industry entered partnerships and developed market-based tools in order to foster change in the seafood industry.

The theory of change (Roheim et al. 2018, p. 392) behind their logic was to say that consumer demand had the power to drive change in the production. Therefore, the role of the NGOs was to harness consumer demand to create economic incentives for well-managed fisheries.

To help consumers make responsible choices, NGOs developed guides (e.g. Monterey Bay Aquarium Seafood Watch[10]) and eco-labels (e.g. Marine Stewardship Council,[11] Friends of the Sea[12]) in order to provide signals of 'measurable' sustainability (Bush and Oosterveer 2019, p. 2). These initiatives led to the development of norms, principles and standards attempting to "define and codify sustainability" (Bush and Oosterveer 2019). Building on the key principles of the existing legal regime under UNCLOS, and concentrating, similarly, on the process of production, these initiatives went further by translating these principles into evidence-based criteria (Bush and Oosterveer 2019). This approach draws on the 'audit culture' that believes a phenomenon should be measured in order to be managed (Parlee and Wiber 2014, p. 98). Using performance indicators and benchmarks, the auditing process measures different properties (e.g. environmental, ecological, institutional) of the phenomenon (Parlee and Wiber 2014, pp. 96–111). From there, it evaluates how it performs against a specific standard. The audit is usually checked by an independent, trusted third party, to increase credibility. Auditing originally sought to measure and provide information on fisheries' sustainability achievements (Parlee and Wiber 2014, p. 98). In practice, it is often

[10] https://www.seafoodwatch.org/.

[11] https://www.msc.org/.

[12] https://friendofthesea.org/.

Table 1 MSC Fisheries Standard (MSC 2018)

Principle 1: Sustainable target fish stocks
A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.
Principle 2: Environmental impact of fishing
Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.
Principle 3: Effective management
The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

used to "create behavioural changes among target groups", pushing for individual performance (Parlee and Wiber 2014).

The first initiative of its kind and scope is the Marine Stewardship Council (MSC) initiative, which is still regarded today as the leader in the market (CBI Ministry of Foreign Affairs 2021). It all started with the unexpected decision of the WWF and Unilever to partner and create the MSC in 1996. Following this, extensive international consultations and discussions took place involving technicians and scientists as well as many stakeholder organisations, such as NGOs, fish processors, retailers, groups of fishermen, academic institutions and government research institutions, in order to define what a sustainable fishery should be.[13] At the end of the process, three principles were established to recognise sustainable fisheries (Table 1).

These 3 principles, largely inspired by the international law of the sea, were further divided into 28 performance indicators (PIs) (6 PIs for Principle 1, 15 PIs for Principle 2 and 7 PIs for Principle 3). Detailed instructions and guidelines also add information on how to assess the different PI (MSC 2018, p. 3). With this level of precision, the standard aims to bridge the gap between the theoretical principles set out in international instruments and their practical implementation by governments. These PIs, guidelines and instructions have evolved over the years, in response to criticism by other NGOs or stakeholders.[14] New public rules and private initiatives seek greater professionalism and improved regulation of eco-certifications in order to maintain trust in the sustainable seafood movement.

6 Interactions of Norms: Collaboration and Competition

As the number of seafood certification schemes and voluntary claims exploded, fear of confusion and misleading information rose. The EU had been discussing the possibility of regulating eco-labels, or even creating a public fishery eco-label (Directorate-General for Maritime Affairs and Fisheries 2016). It finally decided not to take these options, afraid it would raise consistency issues through "a dual role of the EU in improving environmental sustainability through the [Common Fisheries Policy] and setting criteria for assessing sustainability" through an eco-label (Directorate-General for Maritime Affairs and Fisheries 2016, p. 10). However, to ensure the credibility of a certification scheme, EU regulations are meta-governing (Samerwong et al. 2017) eco-certification. Indeed, provision of environmental information on a voluntary basis is allowed, provided that it is

[13] For a more detailed idea of the debates, see Kumar (1998).

[14] See review process on the MSC website <https://www.msc.org/standards-and-certification/developing-our-standards/the-fisheries-standard-review>, accessed 1 February 2022.

clear, unambiguous and verifiable.[15] In the area of certification, requirements for accreditation are set by Regulation (EC) No 765/2008.[16] In line with this Regulation, certification bodies are controlled by one single national public accreditation body.

Besides these mandatory regulations, other global voluntary standards have been developed to provide guidance on voluntary claims, such as those of the FAO, the International Organization for Standardization (ISO),[17] the ISEAL alliance[18] and the Global Sustainable Seafood Initiative (GSSI),[19] setting up 'standards of the standards' (Bush and Oosterveer 2019, p. 2), using the same audit approach. The MSC itself states on its website that it is compliant with standard setting best practice, listing the following standards: FAO Code of Conduct for Responsible Fishing, FAO Guidelines for the ecolabelling of fish and fishery products from marine capture fisheries, GSSI benchmarking tool, ISEAL Standard-setting code of good practice, ISEAL Impacts code of good practice, ISEAL Assurance code of good practice, ISO 17011 (accreditation), ISO 17065 (certification) and ISO 19011 (auditing) (MSC 2022).

With public and private regulations and standards influencing the MSC standard, the latter has had a massive influence when it comes to national and international fisheries regulations (Karavias 2019). Indeed, for each assessed fishery, a detailed plan is provided on how to improve national and international regulations in order to obtain certification. Attracted by the economic returns of their fisheries' potential certification, governments are often willing to implement the standard's requirements by adapting their national laws or influencing RFMOs regulations. The Indian Ocean Tuna Commission RFMO (IOTC) Resolution 16/02 (IOTC 2016) is an excellent example, as it sets up harvest control rules and reference points that correspond exactly to the conditions required for the Maldives Skipjack Tuna Fishery to achieve MSC certification (Karavias 2019). The Action Plan, set up by the independent assessment body for MSC in 2009, required the involvement of the Maldives government in order to get a new Resolution at the IOTC level. The MSC Fisheries Standard and Guidance (MSC 2018, pp. 153–156) requested to set the biomass limit reference point to 20% of the unfished spawning biomass, and the biomass target reference point to 40% of the unfished spawning biomass. Following through on this Action Plan, the Maldives government demonstrated its commitment to "provide the necessary support to achieve the implementation of [the] Action Plan" (Ministry of Fisheries and Agricultures of Maldives 2012). The push for a new resolution by the Maldives government at the IOTC (IOTC 2015) culminated in the adoption of Resolution 16/02 and the certification of the Maldives Skipjack Tuna Fishery.

Other initiatives are also using the MSC standards as their own standard. Fishery Improvement Projects (FIP) aim to help problematic fisheries improve their management in order to gain better access to international markets.[20] An FIP is a pre-competitive collaboration allowing different levels of stakeholders to join forces to address environmental challenges in a fishery (Conservation Alliance for Seafood Solutions 2021). Increasingly driven by suppliers and industry, and less and less by NGOs, the FIP model is spreading all over the world (CEA Consulting 2020). It requires assessment of the fisheries against the MSC standards to guide and prepare the improvement project. The Ecuadorian Mahi Mahi FIP worked with the government of

[15] Regulation (EU) 1379/2013 of the European Parliament and of the Council of 11 December 2013 on the common organisation of the markets in fishery and aquaculture products, amending Council Regulations (EC) 1184/2006 and (EC) 1224/2009 and repealing Council Regulation (EC) 104/2000 (CMO Regulation) [2013] OJ L 354/1, art. 39(1) and 39(4).

[16] Regulation (EC) 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) 339/93 [2008] OJ L 218/30.

[17] https://www.iso.org/home.html.

[18] https://www.isealalliance.org/.

[19] https://www.ourgssi.org/.

[20] See https://fisheryprogress.org/.

Ecuador to improve the management of its fishery.[21] For that purpose, and under the leadership of the WWF, they developed with the government a National Plan of Action aligned with the FIP workplan. This resulted in improvements to national regulations, such as better data collection and analysis, an on-board observer programme, a closed season and a minimum landing size. Since then, other FIPs (the small pelagic FIP and tuna FIP) in Ecuador and elsewhere (e.g. Peru[22]) have been using a similar model of a National Action Plan (CEA Consulting 2020).

More and more initiatives are seeing powerful stakeholders (retailers for the most part) join forces to put pressure on governments to implement the MSC standard (Neil Daly 2020). In February 2020, international buyers wrote an open letter to Thailand's government to preserve fishery reforms (International Buyers 2020). Another letter signed by 22 members of the Sustainable Seafood Coalition (SSC)—all major buyers of seafood in the UK—was sent on September 8, 2020, to the UK government asking for vital changes to be made to the Fisheries Bill, under discussion at the time (ClientEarth 2020). Letters and statements to RFMOs are also numerous, such as those from the Global Tuna Alliance (GTA) and the Tuna Protection Alliance (TUPA), concerned that "MSC-certified fisheries in the WCPFC will have their certifications suspended in 2022 [and t]his will impact the availability of MSC-certified tuna in the marketplace, as the WCPFC is the largest source of tuna for most western markets" (GTA and TUPA 2020). The North Atlantic Pelagic Advocacy Group (NAPA)[23] also decided to set up a 'policy' FIP[24] even though their fisheries are in a healthy biological state. Although still unresolved, the issue lies at the management level and requires all fishing states to secure an agreement on TAC in line with scientific advice for the fisheries to stay MSC certified (The Fishing Daily 2021).

The auditing approach dominating the sustainable seafood movement appears to be effective in influencing legislation. However, it has the weakness of being rigid and uniform. Indeed, even if some indicators are not suitable, participants will have to implement them. Diversity is therefore not encouraged. The MSC standard works well in a top-down centralised large-scale organisation. However, it has proved much harder to implement when it comes to small-scale fisheries, coastal fishing communities or co-management systems (Parlee and Wiber 2014, p. 106).

7 Conclusion

Using a global and historical perspective, we have been able to observe the different layers of norms influencing the sustainability of the fishery sector: (1) local arrangements to self-regulate, (2) international principles implemented through top-down command-and-control national legislation, and (3) 'voluntary' auditable standards with measurable indicators. Each of the layers have created norms that currently compete, complement or replace each other, and influence actors' behaviours (Parlee and Wiber 2014, p. 98). The second and third layers appear to be dominating the scene, working and interacting with each other quite efficiently from a normative perspective. However, this carries with it the risk of a uniform approach in quite a diverse sector. Awareness of the dominant themes could guide the different actors to encourage more minor and marginalised melodies, such as those that could strengthen the social and cultural aspect of the concept of sustainability (e.g. community-led and co-management approaches). Increasing the diversity of the approach could ease adaptation to whatever the future may hold.

[21] https://fisheryprogress.org/fip-profile/ecuador-mahi-mahi-longline.

[22] https://fisheryprogress.org/fip-profile/peru-mahi-mahi-longline-wwf.

[23] https://www.seafish.org/responsible-sourcing/fisheries-management/north-atlantic-pelagic-advocacy-group/.

[24] https://fisheryprogress.org/fip-profile/northeast-atlantic-ocean-mackerel-and-herring-hook-line-trawl-and-purse-seine.

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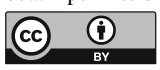

Blue Economy and Sustainable Development Beyond Boxes

Thauan Santos

Abstract

The 2030 Agenda is made up of 17 Sustainable Development Goals (SDGs) and 169 targets. However, when it comes to the marine and maritime environment, references are often only made to SDG 14, which limits the integrated nature of the Agenda. Therefore, this chapter aims to map the broader extent of the seas and ocean in this Agenda, within the different SDGs. As part of our approach, we will highlight the integrative and transversal perspective of the blue economy, analysing the Brazilian case. As part of the main findings, we propose that the seas and ocean should be considered far beyond SDG 14, especially due to the direct and indirect interaction of this SDG with the others. In addition, and considering the context of the UN Ocean Decade, it is necessary to understand the strategic relevance of this environment and these resources in promoting sustainable development.

Keywords

Sustainable development · SDG · 2030 Agenda · Blue economy · Ocean

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1 Introduction

The global political agenda has expanded its range of topics and actors in order to face the challenges of contemporary society. In this context, topics that were traditionally marginalised within the scope of International Relations have begun to earn greater relevance, in more recent years. Such topics include the environment, climate, and sustainable development.

Discussions on these issues began to appear with greater emphasis and frequency from the 1970s onwards due to a variety of factors (Pott and Estrela 2017), such as (i) international oil crises (1973 and 1979); (ii) publication of 'The Limits to Growth' by the Club of Rome (1972); (iii) the eco-development concept, from the Stockholm Conference (1972); (iv) the importance of environmental education, with the Belgrade Charter (1975); and (v) the Intergovernmental Conference on Environmental Education, between the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP) (1977).

However, it was at the beginning of the twenty-first century that society witnessed the first major global effort to promote sustainable development. In 2000, the Millennium Development Goals (MDGs) emerged, totalling 8 goals, 18 targets and 48 indicators. Fifteen years later, the 2030 Agenda and its Sustainable Development Goals (SDGs) were launched. Based on

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the MDGs, the SDGs totalled 17 goals, 169 targets and 232 indicators.

In discussions on a number of themes, seas and ocean are often associated with SDG 14. Notwithstanding, this chapter will criticise this perspective, considering it to be limited and inconsistent with the 2030 Agenda itself, which is intended to be bold, transversal and interconnected. In this sense, we propose a broader view of sea resources from the concept of blue economy; rather than focusing only on marine life, we place the seas and ocean at the centre of the 2030 Agenda, particularly because of its long-term horizon and its cross-cutting nature.

The structure of the chapter will follow that of the qualitative research undertaken, which used a method based on official documents, primary data and a case study. Accordingly, the chapter will first present a review of the initial approach suggested by the United Nations (UN) to frame the goals in boxes, which suggests a certain autonomy and independence between the SDGs. This section will consider the documents published by the UN from a normative perspective. It is our understanding that the normative and institutional character of the goals contribute to the effective internationalisation of these commitments. Following this review, the goals and indicators related to SDG 14 will be presented, alongside a proposal for an alternative analysis of the sea which is complementary to SDG 14. In this section, we will first highlight the interlinkages and trade-offs between the different SDGs and the sea, demonstrating that merely considering SDG 14 amounts to a profound limitation of the analysis. The proposed alternative will be based on the concept of the economy of the sea, thus expanding how the 2030 Agenda deals with the seas and ocean. Finally, the case of Brazil will be briefly evaluated, specifically with regard to the role of the sea in the 2030 Agenda. In this last section, we will consider studies that provide a specific analysis of the Brazilian case, in addition to national initiatives by companies and the State.

Thus, we highlight that the 2030 Agenda represents a new impetus towards cleaner, healthier, and more productive and resilient ocean, including the marine resources within them, consolidating the results of the main summits and conferences held so far (Santos 2019). However, contrary to (inter)national analyses, we propose a new approach to understand the role of the seas and ocean from the perspective of the blue economy, especially since SDG 14 is just one way to achieve and measure their sustainable development.

2 Sustainable Development Beyond Boxes

In 2015, the 2030 Agenda was approved, leading to the establishment of the Sustainable Development Goals (SDGs), which came into effect as of January 1, 2016. With 17 interconnected goals, 169 targets and 232 associated indicators, the ambitious 2030 Agenda was adopted by the United Nations (UN) to tackle the major challenges of the twenty-first century. The set of goals, targets and indicators focuses on people, planet, prosperity, peace, and partnerships (known as 'the 5Ps') and can be understood as a more holistic approach in comparison with the MDGs.

The agenda deals with different topics, such as poverty (SDG 1), hunger (SDG 2), good health and well-being (SDG 3), quality education (SDG 4), gender equality (SDG 5), clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9), inequalities (SDG 10), sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), climate action (SDG 13), life below water (SDG 14), life on land (SDG 15), peace, justice and strong institutions (SDG 16), and partnerships for the goals (SDG 17). It is worth noting that SDG 17 has a particular feature, since it deals with means of implementation (MoI), such as finance, technology, capacity, trade, Policy Coherence for Sustainable Development (PCSD), partnership and data (OECD 2015). In parallel, some SDGs also have their own MoI.

Awareness of the risks associated with an interpretation limited to closed boxes around the respective themes led not only to the inclusion of the colour wheel in the SDGs logo but also to broader academic debate on the need to consider and understand the 2030 Agenda in an integrated and combined way. Different actors, be they sub-national, national, or supranational, or public or private, need to consider their activities as part of a whole to be achieved, and not a goal in themselves. In the light of this dilemma, there has been growing debate on clustering of the SDGs, in addition to discussion on how to identify and measure their interdependence and mutual influences, whether positive or negative.

In fact, there are different interlinkages and trade-offs between the 17 goals (Lu et al. 2015; Santos and Santos 2017; Allen et al. 2018; Nerini et al. 2018; Scherer et al. 2018; Breuer et al. 2019; Lusseau and Mancini 2019; Moyer and Bohl 2019; Pradhan 2019). Therefore, the success of the 2030 Agenda depends on the joint reach of the different SDGs, precisely because they need to be thought of collectively. In some cases, as will be shown in the following section, the achievement of a specific goal associated with a given SDG can compromise or even hinder the achievement of another goal, which justifies this complex joint approach.

The nexus approach can provide a wider horizontal and vertical policy integration (Lucas et al. 2016), so 'responsibilities should be defined, accountability systems put in place, and human capacities built accordingly' (Waage et al. 2015, p. 87). As an example, van Soest et al. (2019) put SDGs 13, 14 and 15 together in an earth system cluster, aiming to identify the synergies and trade-offs in meeting multiple SDGs simultaneously, through Integrated Assessment Models (IAMs). In line with these authors who propose different frameworks for structuring and clustering the SDGs, Niestroy (2016) suggests three concentric circles as a tool to cluster the SDGS based on 'well-being' (SDGs 1, 3, 4, 5 and 10), 'production, distribution and delivery of goods and services' (SDGs 2, 6, 7, 8, 9, 10 and 12), and 'natural environment' (SDGs 13, 14 and 15). As already mentioned, SDGs 16 and 17 are 'placed outside the circle' as underlying goals for Means of Implementation and other governance-related targets. (Niestroy 2016, p. 10).

Despite the alternative nature of these approaches, many of them still reproduce the problems they propose to solve and overcome, laying bare the segmented logic of the SDGs. The SDGs are highly influenced by the MDGs, which divide the themes into different goals, targets and indicators; yet it may be limiting to deal with the current challenges of an international system in transition in different areas using the same logic and pre-existing instruments (Santos and Santos 2017). Some of these challenges become even more complex on certain agendas, due to the multi-level governance structure involved. In these cases, it is necessary to consider different layers of hierarchies, putting together trade-offs between domestic and international coordination. This is precisely the case for the seas and ocean.

> Oceans cover more than 70% of the planet's surface and play a crucial role in planetary resilience and the provision of vital ecosystem services. [Given this key role,] the 2030 Agenda for Sustainable Development puts use and conservation of the ocean and its resources, including coastal areas, into the wider sustainable development context for the first time (Schmidt et al. 2017, p. 177).

The main objective of this section was, therefore, to highlight the specialist literature, briefly presenting the theoretical discussion around limitations to a structural way of considering the 2030 Agenda, particularly from its 17 SDGs. In the next section, we analyse the 2030 Agenda with specific focus on the seas, both because these are an important environment for certain economic activities in the future and also because they cover a wide range of sectors and actors who need to interact, both nationally and internationally, to achieve the goals and targets proposed by the 2030 Agenda in an integrated and coherent way. This discussion on a global scale is essential because, although 'the protection of ocean areas under national jurisdiction is increasing, (...) more than 60 per cent of oceans are still beyond national jurisdiction, and only about 1 per cent of the area is covered' (UN 2019, p. 28).

3 The Sea and the SDGs

In the 1980s a broader debate began to emerge on the need to structure global governance of the seas and ocean, especially in the light of the challenges that were arising at that time (Rothwell and VanderZwaag 2006; Ryan 2015). Figure 1 presents a timeline highlighting the main milestones related with this area, taking into account events at UN level.

Considering the context of the SDGs, the analysis of this section will focus on the post-2030 Agenda period (after 2015). As stated in the previous section, the 2030 Agenda can be interpreted as a kind of extension and updating of the MDGs, which already considered marine resources, even if only marginally. In fact, MDG 7 was about ensuring environmental sustainability, focusing mainly on life on land, although target 7.b sought to protect terrestrial and marine ecosystems, addressing, for example, protected coastal areas and overexploitation of fish (UN 2015; Santos 2019). Most likely as a consequence of how this theme was addressed within the scope of the MDGs, the 2030 Agenda would again treat water resources in a limited and biased manner.

To understand this limitation, this section will be divided into two subsections to facilitate an understanding of the methodological approach of this chapter. In the first sub-section, we will analyse the relevance of the seas from the perspective traditionally followed in relation to the 2030 Agenda, i.e. from the perspective of SDG 14. On the other hand, the second sub-section, although it fits within the framework of the SDGs (precisely because it is the current long-term global proposal), is not limited to SDG 14 or simply its interlinkages and trade-offs.

3.1 Stuck Inside the Box

As presented in the previous section, the 2030 Agenda has 17 SDGs, two of which (SDG 6 and SDG 14) deal directly with the 'water' natural resource. SDG 6 seeks to ensure the availability and sustainable management of water and sanitation for all (Essex et al. 2020). However, when it comes to marine resources and, therefore, seas and ocean, different scientific publications, national reports and documents from international organisations focus exclusively on SDG 14 (UN 2016).

In summary, SDG 14 addresses marine pollution (14.1), healthy ocean (restoration of ecosystems) (14.2), ocean acidification (14.3), sustainable fishing (overfishing) (14.4), marine protected areas (14.5), fisheries subsidies (14.6), economic benefits for Small Island Developing States (SIDS) and Least Developed Countries (LDCs) (14.7), knowledge and technology (14a), small scale fishers (14b), and development and implementation of law (14c). SDG 14's focus on the biological and environmental perspective is, thus, quite evident, while also considering the asymmetry between different states in the international system with specific reference to SIDS and LDCs.

As indicated above, most works on the relevance of the seas and ocean in the 2030 Agenda tend to focus exclusively on SDG 14. They only consider the seas and ocean as an environment that can be polluted and, therefore, that must be preserved. The social and economic view associated with activities that depend directly on the seas and ocean is discredited, appearing only marginally in goals 14.4, 14.6 and 14.b (which deal with fishing, including artisanal activity) and 14.7 (which deals with economic benefits for SIDS and LDCs).

As regards the SDG clustering proposal presented in the previous section, van Soest et al. (2019) show little interaction between SDG 14 and the other SDGs, the closest interaction being with SDG 13 (climate change). Le Blanc (2015) stresses the close relationship between SDG 14 and SDG 8 (growth and employment) and SDG 12 (sustainable consumption and production), concluding that the SDGs are completer and more interconnected than the MDGs. The OECD (2015) highlights the close relationship between SDG 14 and the environment dimension of the 2030 Agenda, although some of its targets touch the economic (14.1,

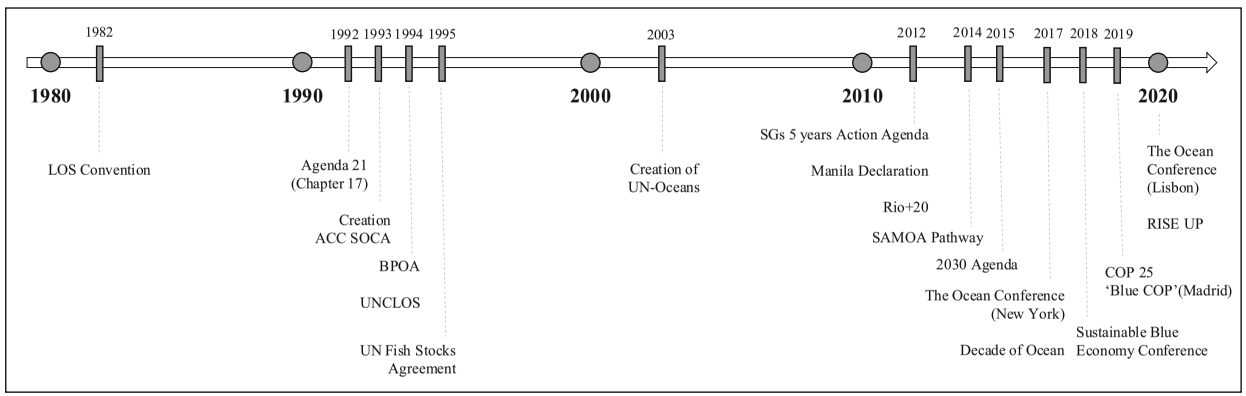

Fig. 1 Main sea-related milestones on the global agenda. Source: Own elaboration; *LOS* Law of the Sea, *ACC SOCA* Areas of the Administrative Committee on Coordination – subcommittee on Oceans and Coastal Areas, *BPOA* Barbados Programme of Action, *UNCLOS* United Nations Convention on the Law of the Sea, *SAMOA* SIDS Accelerated Modalities of Action, *SIDS* Small Island Developing States, *RISE UP* a blue call to action, *COP* Conference of Parties

14.3, 14.4, 14.5, 14.6 and 14.7) and social (14.3, 14.6 and 14.7) dimensions.

The SDSN (2015) proposes three monitoring levels for SDG14, namely national, global and thematic. Among the themes to be considered, its close relationship with SDGs 2, 6, 12, 13 and 15 is stressed, especially when it comes to pollution, protection, resilience, ocean acidification, overfishing, sustainable management, biodiversity loss, illegal, unreported and unregulated (IUU) fishing (at the national level), nutrition, scientific cooperation, economic contribution, and ocean health. The Council's 2017 report proposes an analysis beyond trade-offs and synergies through the seven-point scale, suggesting some extra relations between SDG 14 and the other SDGs not aforementioned—in line with Santos (2019). Table 1 shows the co-benefits between SDG 14 targets and other SDGs based on a colour scale.

Therefore, SDG 14 has a closer relationship through co-benefits with SDGs 1, 2, 11, 13 and 15. In practice, there is a strong trade-off relationship with SDG 2 (OECD 2015) and SDG 11, which can eventually become synergies (Kroll et al. 2019) from the appropriate stimuli if mutual policies and strategies are adopted. These interlinkages and trade-offs are quite limited, however, because, despite SDG 14's connection with urgent global themes, it effectively deals only with marine life.

> However, as the political framework that the SDGs provide does not reflect the full picture and as some areas and goals are rather weakly connected (in particular the SDGs 14 Oceans [. . .]), attempts towards policy integration will require the inclusion of studies on biophysical, social and economic systems (Niestroy 2016, p. 12).

Although this may not be the best method for considering the relevance of seas and ocean, even an analysis limited to SDG 14 shows that there are some co-benefits to achieving its targets. In a similar way to SDGs 11, 13, 16, and 17, SDG 14 also has trade-offs and non-associations with other SDGs in the future. Therefore, consideration of seas and ocean in the context of the 2030 Agenda requires a change of perspective, mainly because of the cross-cutting nature of this theme. This will be the main focus of the following subsection.

3.2 Released Outside the Box

Table 1 shows the targets and indicators for SDG 14, which are often used to highlight the relevance of the seas in the context of the 2030 Agenda. Although these targets have interlinkages and trade-offs, we argue that they provide a limited understanding of the real relevance of the seas with regard to the sustainable development agenda. Hence, we propose that the integrative and interdisciplinary perspective of

Table 1 Co-benefits between SDG 14 targets and other SDGs (colour scale)

SDG/ Target	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
14.1																	
14.2																	
14.3																	
14.4																	
14.5																	
14.6																	
14.7																	

Source: Own and adapted elaboration based on Nereus Program; Scale: 100% and 10%

the blue economy should be used, since it highlights the different activities and economic sectors that use the seas and ocean.

Specific to each country, the concept of economy of the sea is limited to activities directly and indirectly related to the seas (Carvalho 2018) and can be understood as a strategic and analytical policy of regional development capable of contributing to the formulation of public policies (Santos and Carvalho 2020). Because blue economy considers a greater diversity of sectors and actors involved in activities directly (and indirectly) related to the use of the seas, this perspective allows the sea to be more easily and appropriately explored, managed, and protected (Santos 2019). Thus, we propose a broader and more comprehensive analysis of the seas with regard to the 2030 Agenda from the perspective of the blue economy. Accordingly, we may highlight several initiatives that have taken place since 2015 (as shown in Fig. 1), including:

- 2017: Announcement of the Decade of Ocean Science for Sustainable Development (2021–2030) and The Ocean Conference (New York, United States);
- 2018: Sustainable Blue Economy Conference (Nairobi, Kenya);
- 2019: COP 25, 'Blue COP' (Madrid, Spain); and
- 2020: "RISE UP – a blue call to action"—officially launched in February, at the preparatory meeting for the UN Ocean Conference.

The Ocean Conference 2020 was scheduled to take place in Lisbon (Portugal) between 2 and 6 June 2020. However, according to their official website note published on 14 April 2020:

> In light of the global coronavirus (COVID-19) pandemic and growing public health concerns, the 2020 United Nations Ocean Conference (. . .) has been postponed per decision 74/548 adopted by the General Assembly on Monday, 13 April 2020 at 3: 01 p.m. Co-hosts of the Conference Kenya and Portugal in consultation with the General Assembly will decide on possible future dates for the Conference, including timelines for the preparatory process.

Thus, 2021 and 2022 seem to be favourable years for expansion and deepening of the debate on the seas and ocean in the 2030 Agenda, both due to the start of the Ocean Decade (2021–2030), and to the postponement of the Ocean Conference (2020). There is a need for this paradigm shift, still within the era of the 2030 Agenda, to ensure that the complexity of sectors related to the seas and ocean is properly addressed in terms of policy and governance design.

Among the sectors covered by the ocean economy, the following stand out: defence and (inter)-national security; fishing and aquaculture; offshore energies; offshore mineral resources; transport, logistics and maritime infrastructure; shipbuilding and repair; tourism, sport and leisure; environment and climate (Santos 2019). These sectors, with their related national and geopolitical impacts, contemplate much more than just 'marine life', which is the focus of SDG 14. That is precisely why this chapter proposes an 'outside-the-box' approach when thinking of the seas, SDG 14 being the 'box' that limits society's broader perception of the sea in the 2030 Agenda. We are not advocating that the SDG approach is inadequate or inappropriate, or something different from what the world has been doing, but by associating the seas only with SDG 14, a biological bias is created, simplifying their intersectoral nature.

Given this context, we propose a perspective that considers the relevance of the seas from the perspective of the blue economy, not limited to SDG 14 but encompassing all the SDGs that have a relationship with socioeconomic activities related to the seas and ocean. Therefore, Table 2 presents other sea-related SDGs, and their targets and issues, beyond SDG 14 itself, based on the sectors related to the blue economy presented above and using key sentences from the 2030 Agenda itself.

As can be seen from the methodological proposal of this chapter, seas and ocean cover a much broader and more transversal spectrum in the 2030 Agenda. Unlike Table 1 and the discussion of interlinkages and trade-offs presented in the previous section, which were limited to identifying the relevance from the perspective of the SDG 14 targets, Table 2 demonstrates how different targets of sea-related SDGs have an

Table 2 Other sea-related SDGs beyond SDG 14, and their targets and issues

SDG	Target	Sea-Related Issue
1	**1.1**	'eradicate extreme poverty for all people everywhere'
	1.2	'reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions'
	1.5	'reduce their exposure and vulnerability to climate-related extreme events'
	1.a	'provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies'
	1.b	'sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies'
2	**2.1**	'end hunger'
	2.2	'end all forms of malnutrition'
3	**3.9**	'substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination'
6	**6.1**	'achieve universal and equitable access to safe and affordable drinking water for all'
	6.3	'improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials'
	6.4	'substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity'
	6.5	'implement integrated water resources management at all levels'
	6.6	'protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes'
	6.a	'expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes'
	6.b	'Support and strengthen the participation of local communities in improving water and sanitation management'
7	**7.2**	'increase substantially the share of renewable energy in the global energy mix'
	7.a	'enhance international cooperation to facilitate access to clean energy research and technology'
8	**8.1**	'Sustain per capita economic growth in accordance with national circumstances'
	8.3	'Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services'
	8.4	'Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation'
	8.9	'devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products'
	8.a	'Increase Aid for Trade support for developing countries, in particular least developed countries'
	8.b	'develop and operationalize a global strategy for youth employment'
9	**9.1**	'Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure'
	9.3	'Increase the access of small-scale industrial and other enterprises, in particular in developing countries'
	9.4	'upgrade infrastructure and retrofit industries to make them sustainable'
	9.a	'Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support'
	9.b	'Support domestic technology development, research and innovation in developing countries'
	9.c	'Significantly increase access to information and communications technology'
10	**10.2**	'empower and promote the social, economic and political inclusion of all'
	10.6	'Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions'
	10.7	'Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies'
	10.a	'Implement the principle of special and differential treatment for developing countries'

(continued)

Table 2 (continued)

SDG	Target	Sea-Related Issue
11	**11.4**	'Strengthen efforts to protect and safeguard the world's cultural and natural heritage'
	11.5	'significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters'
	11.6	'reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management'
	11.b	'substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters'
	11.c	'Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials'
12	**12.2**	'achieve the sustainable management and efficient use of natural resources'
	12.3	'halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains'
	12.4	'achieve the environmentally sound management of chemicals and all wastes throughout their life cycle'
	12.b	'Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products'
	12.c	'Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions'
13	**13.1**	'Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries'
	13.2	'Integrate climate change measures into national policies, strategies and planning'
	13.3	'Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning'
	13.b	'Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States'
15	**15.1**	'ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their service'
	15.5	'Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species'
	15.7	'Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products'
	15.8	'introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species'
	15.9	'integrate ecosystem and biodiversity values into national and local planning'
	15.a	'Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems'
	15.c	'Enhance global support for efforts to combat poaching and trafficking of protected species'
16	**16.7**	'Ensure responsive, inclusive, participatory and representative decision-making at all levels'
	16.8	'Broaden and strengthen the participation of developing countries in the institutions of global governance'
	16.a	'Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries'
	16.b	'Promote and enforce non-discriminatory laws and policies for sustainable development'
17	**17.3**	'Mobilize additional financial resources for developing countries from multiple sources'
	17.6	'Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms'
	17.7	'Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms'

(continued)

Table 2 (continued)

SDG	Target	Sea-Related Issue
	17.9	'Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans'
	17.16	'Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships'
	17.17	'Encourage and promote effective public, public-private and civil society partnerships'
	17.18	'enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data'

Source: Own elaboration based on UN (2016)

impact on the blue economy, which should not be measured only from SDG 14. In the light of the proposed methodological paradigm, the impact of SDGs 1, 2, 3, 6, 7, 8, 9. 10, 11, 12, 13, 15 and 16 on sea and ocean activities is evident. It is also worth noting that some of these SDGs suggest their own means of implementation (MoI).

Among the main activities and sectors involved, the following may be highlighted: socioeconomic development; fishing; research, development and innovation (RD & I); maritime infrastructure; biodiversity and sustainability; and public policies through partnerships with private sectors, as well as through regional and international cooperation. However, although SDGs 4 and 5 were not considered in the analysis, they are also related to the blue economy, for example, through the following targets:

- **4.4** 'increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship';
- **4.5** 'eliminate gender disparities in education and ensure equal access to all levels of education';
- **4.7** 'ensure that all learners acquire the knowledge and skills needed to promote sustainable development'; and
- **5.c** 'Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels.'

In this way, it is possible to identify relationships with education, due to the profile of workers in certain maritime activities, and gender, in fishing and offshore activities, for example. Thus, there is a clear interface between all the SDGs in the 2030 Agenda and activities related to the blue economy, even though, in most cases, these relationships are not even mentioned. This is the case of the relationship with SDGs 7 and 17; in the first case, although it has already been proven that there is enormous potential for sea energies in certain regions (waves, ocean currents, tidal and OTEC, for example), these continue to be marginalised with regard to the current energy transition; in the case of SDG 17, although the goal is to 'strengthen the means of implementation', paradoxically this is ignored in most analyses.

4 Is Brazil in or Outside the Box?

Following on from the literature review and the methodological proposal based on the perspective of the blue economy, this section will briefly analyse the case of Brazil. This analysis makes perfect sense, given that almost 20% of the country's population, production, and formal jobs are related to the ocean economy (Carvalho 2018). In addition, Brazil's coastline is 8698 km long and covers an area of approximately 514,000 km^2, 324,000 km^2 of which correspond to the territory of coastal municipalities, comprising 19 of the 36 Brazilian metropolitan regions on the coast.

In its Voluntary National Review, which aims to provide information about the process of preparing Brazil for the implementation of the 2030 Agenda, the country highlights national

governance, the need to adapt some targets and the consequent definition of national indicators (Brazil 2017). The Review states that 85.8% of the targets and 78.4% of the SDG indicators were related to the Pluriannual Plan (PPA, Portuguese acronym) 2016–2019, which is the main medium-term planning tool for government actions. Regarding the seas and ocean, it presents the National Policy for the Resources of the Sea (PNRM, Portuguese acronym) and the National Coastal Management Plan (PNGC, Portuguese acronym), as well as their interface with the National Plan for Adaptation to Climate Change (PNA, Portuguese acronym), with the Program for Conservation and Sustainable Use of Biodiversity, and with the Fisheries and Aquaculture Program. This shows and confirms that the Brazilian focus given to the seas and ocean is limited to the SDG 14 approach, which has been criticised in this article.

The country established the National Commission for the Sustainable Development Goals, responsible for advancing the process of locating the targets and indicators of the SDGs, which benefits from the participation of civil society, governments and the presidency, as well as the permanent advice of the Brazilian Institute of Geography and Statistics (IBGE, Portuguese acronym) and the Institute for Applied Economic Research (IPEA, Portuguese acronym). Considering SDG 14, the Brazilian adequacy proposal is that, of the 10 targets, all (100%) apply to the country, 3 (30%) have already been adapted to the national reality, 7 (70%) are still being implemented and no target was created (Viana 2017). According to the ODS Brazil Platform, updated on April 1, 2020, only 1 indicator has been produced (14.5.1), 6 are under analysis/construction (14.2.1, 14.6.1, 14.7.1, 14.a.1, 14.b.1 and 14.c.1), and 3 are without data (14.1.1, 14.3.1 and 14.4.1).

In addition, according to the World Resource Institute (WRI), there are no linkages between the Brazilian Nationally Determined Contributions (NDCs) and SDG 14. On the other hand, it is worth noting that in South America, other countries present this relationship between NDCs and SDGs, including Ecuador (2 targets linked), Peru (1), Suriname (1), Uruguay (1) and Venezuela (1). Particularly addressing the cross-impact of prioritised global targets and their interactions in the Brazilian context, Oliveira et al. (2019) provide an empirical method, based on current perceptions of experts about the implementation of the SDG framework at the national level. They show that among the 'determinant targets' that play a key role in the planning and implementation of the 2030 Agenda in Brazil, none comes from SDG 14.

It is, then, evident that the Brazilian case reproduces the analyses and policies carried out abroad. Following the 'recipe', the analyses have considered only the impact of a certain SDG target on the SDG 14 goals and, at most, *vice versa*. However, as demonstrated, this proposal limits the political sphere of action of actors nationally and globally, as the objectives are limited (and framed) by targets, instead of being considered by sector (which would require a more transversal perspective – which, paradoxically, is exactly the 2030 Agenda proposal).

5 Conclusions

Given its particular nature, including from a legal, political and economic point of view, the relevance of the seas (and ocean) must be understood well beyond SDG 14. Even limited inside its box, it is clear that tackling SDG 14 targets is neither easy nor trivial, which we do not intend to suggest through our broader and bolder proposal. SDG 14 *per se* will require robust international cooperation and coordination to protect the ocean and preserve fish and other marine resources. This will require a reformulation of the current governance of the ocean and fisheries, which is often implemented in a disjointed manner by different agencies.

In the perspective inside the SDG 14 box, even the contributions that consider its interlinkages and trade-offs point to little relationship between SDG 14 and the other goals of the agenda, which does not appear to be a reasonable argument given the transversality and capillarity of this sea agenda. In fact, there are too many issues at

stake, so there is no one-size-fits-all perspective to be advocated. Our proposal, therefore, seeks to highlight the relevance that seas and ocean have for coastal States, whose activities associated with the ocean economy are of great relevance for the economy as a whole. This was precisely the reason for analysing the case of Brazil.

Due to the cross-cutting agenda and the multi-level governance structure involved, consideration of the seas in the era of the 2030 Agenda requires a paradigm shift in the way concepts are designed and policies implemented. Hence, given that a significant share of the ocean is still beyond national jurisdiction, there is no place for state-centric-based policies, and better and wider regional integration and international cooperation is required. The methodological proposal of this chapter not only considers the peculiar nature of this agenda, but reinforces the broader, circular, transversal and interdisciplinary perspective of the 2030 Agenda.

Taking advantage of the fact that 2021 and 2022 are paradigmatic years for the global agenda of seas and ocean, due both to the Ocean Decade (2021–2030) and to the Ocean Conference, scheduled to take place in 2020 but postponed until 2022 due to the COVID-19 pandemic, the proposal in question could not come at a more opportune time. As seen in the Brazilian case, the country is still in the initial stage of implementing the agenda, having produced only 1 of the 10 indicators of SDG 14, which is not even related to the Brazilian NDC. Therefore, the country is still in time to change the perspective for the sea agenda, using the logic of the SDGs, albeit in a more integrated and interdisciplinary way, based on the concept of the blue economy.

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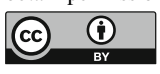

Part IV

Law, Genetic Resources and Biotechnology

A Legal Approach to Fostering Green Infrastructure for Improved Water and Energy Efficiency

Paula Castro and Raquel Carvalho

Abstract

Over the last 30 years, numerous protocols, agreements, and conventions were signed to ensure that environmental protection related to climate change, pollutants, biodiversity, soil erosion, and water quality, among others, is part of the agenda, and the language of ecology has been introduced into political discourse and public policies. However, this does not appear to have been sufficient and there remains a need for national and international instruments that respect all future citizens.

Buildings account for around 40% of EU energy consumption and 36% of greenhouse gas emissions. Ways of reducing the energy consumed by buildings have already been developed, in addition to methods to improve water management. One such approach is the so-called ecosystem service-based approach for green infrastructure, with nature-based solutions that involve much more than bringing nature to cities. Green roofs retain water in times of heavy rain, especially in "waterproof cities", mitigate the heat island effect and contribute to thermal efficiency of buildings. and air quality, with a significant effect in public health.

Current construction standards do not lay down strict environmentally friendly solutions. Laws and regulations have yet to become goal-oriented, holistic, and interdisciplinary. How could (r)evolution in the law help green infrastructures to thrive?

Keywords

Green roofs · Climate change · Energy efficiency · Sustainability · Urban law · SDGs 11 and 13

1 Introduction

When faced with extreme, unpredictable climate change-related situations, society's apparent lack of awareness and the insufficient technical preparation of political and administrative agents are barriers to implementing preventive measures and solutions to mitigate the intensity and harmfulness of environmental events. Any reflection on this matter must therefore consider two major spheres of action. A first focus must be on how to address current situations affecting biodiversity and human health, resulting from the global rise in temperature, shortages of drinking water (and lack of access to water) and pollution in general,

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among others. Simultaneously, it is essential to reflect on how to prevent any worsening of the current situation to avoid reaching the point of no return, and the inevitable desperate poverty and waves of migration that would ensue. It is no longer simply current sustainability that is sought, but rather future sustainability. Solutions must be found to increase society's resilience to the environmental unpredictability we are already experiencing, and work must be done to slow down its intensity and progress.

From a legal perspective, the issue of sustainable development is usually perceived through the legal rules governing economic activities and the functioning of the market, in addition to direct actions on the natural environment, and the range of existing legal instruments extends from the regional and national to the international and global.

The last three decades of legal environmental protection against climate change, pollutants, biodiversity in general, soil erosion and water quality have mainly been centred on the environmental issues *per se* rather than on their integration with other strategic planning frameworks, such as urban planning and urbanisation. However, urbanisation does, indeed, lead to (micro)climatic changes (Freitag et al. 2018; Paul et al. 2018; Şimşek and Ödül 2019; Din Dar et al. 2021). While it may not be immediately evident, buildings play a significant role in impacting the ecosystem. Governments and international organisations have so far failed to give the urban dimension the attention it warrants, when designing legal rules and restrictions. And yet, nature-based solutions combining biotechnology have existed for some time now, and are key in addressing climate, water, and energy problems, such as floods and droughts, and can also promote climate control. Efforts should be made to incorporate these solutions into urban law, first as incentives, and then as mandatory requirements within urban planning and construction, so as to promote more resilient urban ecosystems.

Blue-Green Infrastructures (BGI) are a key instrument in increasing resilience to adverse environmental and climatic conditions and can contribute to reducing the intensity of these conditions in the future. These structures offer direct and indirect benefits and equate to effective action by society. One area where they can be particularly useful is urban planning, specifically building construction. BGI have been described as a "network of interconnected wetlands, basins, and natural spaces, forming an essential means for coping with extreme weather conditions/floods" (Jeong et al. 2016; Din Dar et al. 2021). They include several technological solutions such as rain gardens, bio-swales, bio-retention cells, permeable pavements, green walls, and green roofs. These solutions have been gaining importance due to the "increasing evidence of [their] social, environmental, and health benefits" (Benedict and MacMahon 2006; Din Dar et al. 2021), which have long been recognised. BGI fall within the category of Nature-Based Solutions (NBS), which the United Nations Organization regards as a tool to accomplish several of the Sustainable Development Goals (SDG): "good health and well-being (SDG 3), clean water and sanitation (SDG 6), sustainable cities and communities (SDG 11), climate action (SDG 13), (. . .), and protection, restoration and promotion of sustainable use of terrestrial ecosystems (SDG 15)" (Cohen-Shacham et al. 2019, pp. 20, 22; Calheiros et al. 2022, p. 2).

We have chosen green roofs to demonstrate a simple urban solution within everyone's reach that can play a part in the fight against climate change. The next section provides a more technical description of this solution.

2 BGI and Green Roofs in the Urban Context

The term "green roofs" refers to green infrastructures established on the top of buildings the impact of which is much more than simply bringing nature into cities (European Environment Agency 2020; Abass et al. 2020; Devon County Council 2020; Pearlmutter et al. 2020, p. 1).

A green roof is an engineered multilayer structure that seeks to mimic nature. Underneath the visible top layer of vegetation there is, generally, a substrate that supports plant growth, a drainage

layer for collecting water, and membranes that separate and interconnect the various layers. Green roofs retain water in times of heavy rain, especially in waterproof cities, and can serve as basins for storing water to be used in buildings for a range of purposes. They also mitigate the so-called heat island effect (whereby cities are warmer than their rural surroundings) and contribute to the thermal efficiency of buildings—at the same time helping to reduce energy consumption and combat energy poverty—as well as producing benefits in air quality. The health and social dimension of implementing such structures in cities goes far beyond all measurable outcomes.

A range of technical guidelines have emerged in recent years for best practice in green roof design and implementation, also incorporating location-specific features. These guidelines are an excellent starting point for disseminating this tool. By way of example, we may highlight the German FLL guidelines (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau 2008) and the Portuguese Technical Guide for Green Roofs (2020).[1] The design of the infrastructure should take into account the local climate conditions, which influence the choice of plants, and the local availability of materials, including substrates for plant growth and material for water retention. The assembly of the plants and materials drives the system's performance, which is measured by the target outcomes, such as improvement of water quality and stormwater management (Monteiro et al. 2015, 2017a, b).

3 BGI and Urban Law: A Perfect Match?

3.1 Positive Impacts of BGI and Green Roofs

Like many technological solutions, green roof infrastructures have both positive and less positive impacts.

Some of the positive impacts described in the literature include:

(i) Reduction of water quantity in situations of intense or diluvian rainfall. Storm water retention is usually the first benefit mentioned (Getter et al. 2007, p. 226; Carter and Fowler 2008, p. 151). This benefit can be very relevant for cities' sewer systems, preventing overflows;

(ii) Improvement of water quality through biological and mechanical purification processes, with the elimination of heavy metals, suspended pollutant particles or other pollutants from the air and from the water itself, implying benefits to the water cycle (Liberalesso et al. 2020). Some studies indicate a positive effect of reducing acid rain levels, with a positive impact on the control and combat of air pollution.[2] Despite a lack of data regarding CO_2 capture, it must be stressed that, overall, green roofs make an important contribution to fighting air pollution (American Rivers et al. 2012, p. 32);

(iii) Temperature control of public and private built spaces. Urban areas are known to be warmer than non-urban areas due to the lack of vegetation cover and due to human activity, and growing demand for housing is yet another source of stress in this regard (Mittermüller et al. 2021, p. 40). Green roofs can capture heat during the day and release it at night, contributing to a smaller temperature range. Depending on the structure, there may be benefits for public spaces, such as shade on roadways or vegetation cover on buildings by means of the evapotranspiration process (Koc et al. 2018; Mittermüller et al. 2021).[3] Temperature variations are not generally beneficial to

[1] Guia Técnico de coberturas verdes. 2020 ANCV.

[2] Referring to a study from 2007, American Rivers et al. (2012, p. 29, 44).

[3] Din Dar et al. (2021); Mittermüller et al. (2021, p. 49) (referring to the relationship between tall buildings and narrow streets as a factor to "increase daytime thermal comfort by providing shaded walkways". However, it has the drawback of being less thermal friendly in cold weather); American Rivers et al. (2012, p. 18).

human health (American Rivers et al. 2012, p. 16; Mittermüller et al. 2021, p. 49). Some studies have demonstrated a decrease in the impact of these, specifically a decrease in heat-related deaths, when urban planning incorporates BGI solutions (Din Dar et al. 2021);

(iv) Possible generation of micro-climates in cities which may contribute effectively to balancing temperatures (Din Dar et al. 2021);

(v) Climate control through reduction of the temperature range, leading to less energy being spent on climate control technology both to heat and to cool buildings (American Rivers et al. 2012; Din Dar et al. 2021).

In addition to the above, BGI in general provide other benefits that may not be easily measurable, either because their effects are more long-term, or due to the location or the difficulty in aggregating comparable data. Some of these benefits relate to (i) improvements in urban spaces, enabling the recovery of fauna and flora; (ii) decreases in noise pollution through the use of BGI on pavements (Liberalesso et al. 2020); (iii) mandatory green structures in urban planning, such as gardens and green corridors; (iv) recreational spaces to play sports or to socialise, which contribute to social engagement and improve mental health; (v) investment in the sustainability of buildings and cities as a tool for organising space and territory, enhancing real estate development and the value of cities (Liberalesso et al. 2020; Calheiros et al. 2022, p. 236); (vii) increases in green employment (American Rivers et al. 2012); and (vii) improvements in sanitary conditions in cities and the consequent decrease in the demand for health care.

Nevertheless, there are also some difficulties associated with the use of BGI. Firstly, it is not always easy to accurately determine the actual benefits and advantages of these structures given the diversity of the structures themselves, their location, and the type of vegetation used.[4] When considering location, whether the BGI is in a public space or in a private building will be relevant; and, in the case of a building, its height and construction materials need to be considered. For both scenarios, the constancy/inconstancy of the location's climate conditions is decisive for the choice of the structure. Although there are some studies on this subject, it is clear that more are needed and that these should be more in-depth (Din Dar et al. 2021). The difficulties mentioned above highlight the need to incorporate BGI into public policies and into the actions of administrative bodies and entities. In addition, since these structures are not yet in widespread use, there is a need to explain their costs, in some cases because they will affect individuals, and in others because they will affect the public budget. It is essential that an effective policy is developed to communicate the life cycle cost gains that these structures bring to people's daily lives (Din Dar et al. 2021). Normally, these benefits are neither "internalized by the building owner" (Carter and Fowler 2008, p. 152) nor by the public bodies who regulate such issues. Although some additional costs are involved, there are lifetime gains (for the individual and for the community), even if these structures require higher maintenance and the buildings themselves need to support a heavier load. This is one of the conclusions in the report *Banking on Green*: "green roofs may be more expensive than traditional counterparts but provide life-cycle efficiencies that make them less expensive over time" (American Rivers et al. 2012, p. 15). An effective communication policy will also help raise awareness of the importance of multidisciplinary solutions in solving global challenges. There is still some scepticism regarding this kind of solutions, not only due to their cost, but also due to the absence of accurate data on their benefits. Use of these instruments by public entities could, thus, help increase confidence in them. However, it is necessary to address social differences among citizens, which may hinder some individuals' access to this kind of solutions.

[4] Identifying such difficulties, (Mittermüller et al. 2021, p. 42).

4 Worldwide Solutions

Across the globe, various solutions have been adopted to foster the implementation of green roof technologies,[5] such as:

(a) Development of public policies to raise awareness of the importance of greenery in urban areas. Examples include Sydney (Green Roofs and Walls Policy); London (Living Roofs and Walls); Eindhoven; Hamburg (Green Roofs Strategy); Berlin (the city began implementing green roofs in 1988, imposing requirements for implementation); Karlsruhe (the first policies were adopted in 1982); Stuttgart (since 1980); Munich; Zurich (since 1991, all flat roofs which are not used as terraces must be turned into green roofs when building new housing developments, or renovating older ones[6]); Linz (considered a pioneer city, with green roofs being officially introduced in the city's development plans in 1985);[7] Copenhagen (the city has adopted a mandatory green roof policy as part of its bid to become the first Carbon Neutral Capital); Atlanta; Cincinnati (Green Roof Loan Program); Chicago (Green Permit Program); Toronto (the first city in North America to have a green roofs policy); Bogota (Agreement 418 of 2009); Portland (Ecoroof Floor Area Ratio - FAR); Seattle.

(b) Financial incentives for the construction of green roofs (direct and indirect incentives, subsidies, etc., sometimes related to mandatory maintenance of the spaces for a period of time):[8]

(i) In Europe: Portugal with the Environmental Fund programme for sustainable buildings;[9] Barcelona; Lille (subsidy per m^2); Aalst; Courtrai; Kuurne; Oostende; Eeklo; Ghent; Bornem; Mechelen; Antwerp; Turnhout; Leuven; Eindhoven; Breda; Tilburg; Den Bosch; Capelle aan den Ijssel; Rotterdam; Delft; Leidschendam-Voorburg; Den Haag; Leiden; Nieuwegein; Utrecht; Amstelveen (the subsidy varies according to the extent of coverage); Amsterdam; Soest; Harderwijk; Apeldoorn; Almelo; Bocholt; Nijmegen; Dusseldorf ("Climate-friendly living in Dusseldorf"); Cologne; Munster (the incentive is a reduction in rain tax); Hengelo; Hamburg; Brémen; Hoorn; Leeuwarden; Smallingerland; Groningen; Oranienburg; Berlin (Energy Efficient Refurbishment program); Giessen; Frankfurt; Mannheim; Karlsruhe (fee reduction); Stuttgart (fee reduction); Munich (fee reduction); Linz; Graz; Vienna; Brno; Prague; Lausanne; Venice (infrastructure cost reduction); Heemskerk; mandatory maintenance for 15 years (Merelbeke and Wijnegem); mandatory maintenance for 10 years (Hamme; Sint-Niklaas; Herentals; Dessel; Stuttgart; Prague).

(ii) In Asia: Singapore building subsidies (e.g. Skyrise Greenery Incentive Scheme—SGIS); Shenzhen (Urban Greening Uplifting Work Plan); Shanghai (The Shanghai government is providing its own subsidies to promote different specific features of green buildings related to energy saving[10]); Chongqing (there are two types of incentives—public construction and private construction premiums that are

[5] For comparison and details regarding the specific policies, Policy map: https://www.greenroofs.pt/pt/mapa-politicas. The references in Liberalesso et al. (2020) also contain links to many of the cities mentioned in this chapter.

[6] https://www.greenroofs.pt/pt/politica/zurique.

[7] https://www.greenroofs.pt/pt/politica/linz.

[8] The tax reduction regarding property or stormwater fee discount, applied by municipalities, is considered to be a benefit of promoting green infrastructures (Liberalesso et al. 2020).

[9] https://www.fundoambiental.pt/ficheiros/regulamento-edificios-sustentaveis-pdf.

[10] https://www.greenroofs.pt/pt/politica/shanghai.

processed after one year of installation and maintenance); Nagoya (the city has a system of financial incentives and a certification system for green facilities that, under certain conditions, counts towards housing loans—Nagoya City Private Facility Greening Support Program | The System of Greening Area | NICE GREEN Nagoya); Seoul (the city offers an indirect financial incentive due to the high cost of land acquisition);[11] Beijing (incentives are offered for developers).

(iii) In the Americas: Nashville (Green Roof Rebate | Nashville Stormwater Management Incentives); Austin (Green Roof Density Bonus); Cincinnati (fee reduction - Cincinnati Stormwater Management Credit); Milwaukee (Regional Green Roof Initiative—MMSD Green Infrastructure Partnership Program); Indianapolis; Washington DC (River Smart Rooftops Green Roof Rebate Program; River Smart Rewards and Clean Rivers IAC Incentive Programs); Montgomery (Rain Scapes Rewards Rebate Program); Baltimore (fee rebate—Baltimore Blue Roof Incentive); Philadelphia (Green Roof Tax Credit); New York (Green Roof Tax Abatement); Syracuse (Green Improvement Fund (GIF)); Toronto (Eco-Roof Incentive Program); Bloomington (Unified Development Ordinance); Minneapolis (storm tax rebate); Devens, MA (Financial incentives for LEED projects); Palo Alto (Palo Alto Green Roof Incentive); Mexico City (Plan Verde de la Ciudad de México); Goiania (Complementary Law no. 235/2012); Salvador (Sustainable Certification Program "IPTU VERDE"); Santos (tax incentives—Complementary Law no. 913/2015); Guarulhos (Law no. 6793/2010); Buenos Aires.

(c) Mandatory requirements; financial incentive programmes often include % coverage requirements:

(i) In Europe: municipal regulations in Portugal (Barreiro,[12] Sintra, Espinho,[13] Valongo,[14] Maia[15]); Paris (since 2015 it has been mandatory for new buildings in commercial areas to have green roofs or solar panels); Amsterdam; Hanover (Guidelines for Green Roofing in Urban Development Plans); Stuttgart (requirement that all flat roofs (up to 12° slope) should include green roofs[16]); Basel (all flat roofs should apply green roofs); Zurich (minimum roofing requirements); Prague (Technical Guide for Design, Installation and Maintenance of green roofs in the Czech Republic); Bolzano (Italian guide for the construction of green roofs and strategies for education and information on the subject, *Procedura R.I.E. (Riduzione dell'Impatto Edilizio)*); Turin—*Articolo 21* (green cover obligation when 20% of the land cannot be allocated to green areas); Malmo ("Ecological building", which requires a minimum of green spaces in buildings constructed on land sold by the city and developed by private developers[17]).

(ii) In Asia: Singapore (buildings constructed after 2010 must have green cover); Guangzhou (green cover technical specifications requiring the installation of green roofs including an indication of the type of vegetation);

[11] http://www.winklerpartners.com/wp-content/uploads/2013/05/SSRN-id2242630.pdf.

[12] Regulation No. 712/2019.

[13] Article 46 Building Regime.

[14] Article 92-A of the Municipal Master Plan of Valongo.

[15] Article 29-A "Coefficients of impermeability" of Chapter IV, Section I of Urbanization and Building.

[16] https://www.greenroofs.pt/pt/politica/estugarda.

[17] https://www.greenroofs.pt/pt/politica/malmo.

Hangzhou; Tokyo (The Tokyo Nature Conservation Ordinance (2001) requires private buildings over 1000 m^2 and public buildings over 250 m^2 to have at least 20% green cover (2015 data) and fines are issued for non-compliance); Seoul.

(iii) In the Americas: Toronto (Green Roof By-law); Los Angeles (Green Building Program); San Francisco (Better Roofs Ordinance); São Paulo (Environmental Quota Law, which is a new urban and environmental instrument to be used when issuing urban licences for new constructions and renovations—Decree no. 55.994/2015 and Decree no. 57.565/2016); Blumenau (Complementary Law no. 1174/2018); Porto Alegre (Complementary Law no. 734, of 24 January 2014); Cordoba (Ordinance (2016) establishing the mandatory installation of vegetated roofs in critical areas with respect to air pollution levels and the effect of heat islands[18]); Recife (Law no. 18.112/2015).

5 Urban Law Contributions

While urban planning law is obviously closely connected with land use planning, its relationship with the environment is also a strong one. Many urban law scholars have already acknowledged that there is a public policy dimension to sustainability within urban planning and building, which is presumed to be "one of the most relevant challenges of the 21st century" (Correia and Correia 2021, p. 27), given that increasing population density has created problems of social management and overloading of infrastructures related to environmental issues (Calheiros et al. 2022). The Portuguese Constitution has long been sensitive to this issue, emphasising, in Article 66(2), the connection between the two areas in what is commonly referred to as the urban environment or urban ecology (Correia and Correia 2021, p. 77). At the next level of legislation, the Portuguese Environment Framework Law (EFL) enshrines the principles of sustainable development linked to responsibility to current and future generations, management of water resources, protection of ecosystems, energy sustainability, and safeguarding of biodiversity.[19] The EFL sets out sectorial policies aimed at promoting sustainable development, thus guaranteeing the transversal nature of the public policies included in it. This crossover of public policies led the legislator to include provisions on air quality management in relation to buildings, preservation of water resources and mitigation of floods and droughts, halting of biodiversity loss, climate change, and waste-related issues. This Law also acknowledges the transversal nature of planning instruments (Art. 13) and highlights the importance of environmental performance instruments, such as stimulating demand for eco-design products, eco-efficiency, and services with increasingly reduced environmental impacts (Art. 20). Alongside the EFL, Article 2(b) of the Portuguese Public Policy Framework Law on Land Use, Land Planning and Urban Planning also highlights sustainable development as one of the major objectives in the fight against climate change, through the promotion of natural spaces in cities, leading to energy, environmental and transport sustainability (Correia and Correia 2021, p. 28). This evolution within Urban Planning Law has been further driven by the New Green Deal[20] and the corresponding internal regulation for Portugal's Circular Economy Action Plan. In addition, the influence of European Union Law in these matters is not new: one only needs to consider the importance of environmental impact assessments, strategic environmental assessments and the ecological network (Natura Network), regarding

[18] https://www.greenroofs.pt/pt/politica/cordoba.

[19] Article 3 (a) and (b) of the EFL.

[20] New Green Deal - COM(2019) 640 final, 11.12.2019: the role of cities in combating climate change (point 2.1.1); transport policy (point 2.1.5); enhancing biodiversity in urban spaces (point 2.1.6).

both directives transposed into Portuguese law and CJEU case law (Correia and Correia 2021, p. 63). National law reflects these influences in the field of planning.

Several areas of overlap can be found, beginning with some planning instruments primarily based on environmental needs. This is the case of sectorial programmes intended to implement certain policies in their specific area, namely "risk prevention, environment, water resources, nature conservation and biodiversity" (Article 39(2) of the Legal Regime for Territorial Management Instruments). The legal rules governing the various planning instruments establish urban plans that are binding on private persons, particularly with regard to the organisation of cities and construction. Decisions arising from sectorial plans must be taken into consideration, with the possibility of both plans and administrative acts being deemed unlawful. There are also other legal constraints, which F. Alves Correia and J. Alves Correia describe as "legal land use regimes" (Correia and Correia 2021, p. 154), that can be of great use in the implementation of BGI, namely the National Ecological Reserve and the National Agricultural Reserve. By imposing public utility restrictions, they limit the discretionary planning powers of municipalities regarding the content of Municipal Master Plans (MMP), requiring the municipalities to include measures associated with public policies on water protection, climate change, temperature control, energy use, and "flood risk management plans".[21]

Two important areas in Urban Planning that help to produce maximum benefits regarding temperature control of urban spaces and buildings are urban space planning and building construction requirements (Liberalesso et al. 2020). Calheiros et al. (2022) identify green roofs as having "a long history", but also stress that these have yet to become widespread and replicated in cities in line with that broadly set out in policy and strategic planning. According to Niki Frantzeskaki, a multidisciplinary approach must be adopted if nature-based solutions, including green roofs, are to be successful. Thus, she lists seven lessons drawn from her research: NBS must be "aesthetically appealing for citizens to appreciate and protect them"; they "create new green urban commons"; experiments with NBS "require and build trust between the city and its citizens both for the aim of the experiment and for the experimenting process itself"; "Different fora for co-creating nature-based solutions are needed that include and learn from urban social innovation"; NBS "require a collaborative governance approach. They are often initiated by local governments and require multiple actors to be designed, implemented and linked to urban life"; "An inclusive narrative of mission for nature-based solutions can bridge knowledge and agendas across different departments of the city" and this can help tackle departmental disputes; NBS must be designed so that "lessons for their effectiveness can be easily harvested", thus making it easier to replicate them in other locations (Frantzeskaki 2019). Urban planning can contribute to a city's sustainability via the inclusion of "urban greenery" (Patra et al. 2018, p. 82; Calheiros et al. 2022, p. 237) Studies on BGI have shown that various considerations may be relevant when designing urban planning solutions. For example, whether a particular street is wide or narrow will be a factor when weighing up the pros and cons of constructing tall buildings to combat temperature increases in cities. At the same time, landscape architects have an important role to play in determining the type of vegetation in different scenarios. Since space is limited, it may be necessary to opt for high-rise building solutions due, for instance, to demographic pressure in cities. In such cases, it is important to analyse whether planting deciduous trees is feasible or whether more appropriate infrastructures, such as green façades and green roofs, should be chosen (Mittermüller et al. 2021, p. 50). The best solutions are no longer dictated by aesthetic considerations, but rather by the quality of green spaces, whether these be gardens, green facades or green roofs (Kyttä et al. 2013, p. 43; Klemm et al. 2015, p. 87; Mittermüller et al. 2021, p. 51).

Green roof infrastructures are particularly suitable for urban areas where there is insufficient

[21] Correia and Correia (2021, p. 155). See Council of Ministers Resolution no. 51/2016, of 20 September.

space to build gardens or plant trees at street level. Technically, this kind of structure is incorporated in the "roof membrane" to "support plant communities which are tolerant to the extreme weather conditions found on rooftops" (Carter and Fowler 2008). Not all green roofs are the same, their structure being dependent on the structure of the building itself: intensive green roofs are suitable for commercial buildings and parking lots because of their weight; extensive green roofs, on the other hand, since they have a "much thinner profile which limits plant diversity", are more appropriate for less robust pre-existing buildings (Carter and Fowler 2008, p. 152).

In terms of the law, it is possible that the green roof solution, which has already been adopted in several cities in Portugal and across the world, will become a solution that is recommended for inclusion in architectural projects.[22] Indeed, given the pressure to address climate change, such solutions may even become mandatory (Liberalesso et al. 2020). A requirement to have green roofs could become part of each municipality's MMP, adjusted to align with specific land occupation decisions. For instance, with regard to building requirements, Article 46 of the Espinho MMP (1st September 2016) lays down several parameters related to vegetation. [23] The Plan also includes restrictions of an environmental nature, among others, such as changes in vegetation cover, and the Town Council is able to block the demolition of any built edifice, as well as the cutting or felling of certain trees and other vegetation. These restrictions are protected by a provision that allows a private person's plan to be rejected if it fails to comply with them. In Sintra, on the matter of energy efficiency, Article 49 of the Urbanisation Regulation provides for the use of green roofs, among other instruments (Diário da República 2017). Similar incentives exist in the laws of other European countries. A case in point is the Czech Republic, which has had a central national incentive programme since 2017, and has defined green roof construction requirements for those wishing to access these incentives.[24]

Decisions on the adoption of green roofs must consider, among others, the type of use of a particular area (residential or commercial), the configuration of the land, the biodiversity of the municipality, and other legal and mandatory requirements arising from other planning instruments.[25] Mandatory use of green roof infrastructures will need to be fully explained, and it may also be necessary to provide incentives, such as financial support for the disadvantaged and tax breaks to convince the wealthier sections of society. In Portugal, for instance, in Barreiro, the Municipal Regulation regarding financial support for investment—Regulation no. 712/2019—contains a provision favouring green roofs (Article 7 (b) and (c)). The MMP for the municipality of Valongo also contains a provision that grants financial support for the use of these structures.[26] In addition, financial support is also available from some central administrative bodies. For example, in September 2020, the Ministry of the Environment published its Regulations on the Award of Incentives—Support Programme for More Sustainable Buildings (Diário da República 2020). Regarding thermal insulation upgrades, the regulation seeks to support interventions "that promote the incorporation of biomaterials, recycled materials, nature-based solutions, green façades and roofs and bioclimatic architecture solutions in existing urban buildings or units thereof" (Diário da República 2020). Similar financial tools can be found in other European cities. Barcelona is one example (Associação Nacional de Coberturas Verdes Barcelona 2021), and in Berlin the

[22] Calheiros et al. (2022, p. 237) highlight the important role that the enactment of law could play in the green roof implementation.

[23] https://portal.cm-espinho.pt/fotos/categorias_informacao_ficheiros/1.1_rpdme_publicacao_em_dr_172014729359afc5ae454fd.pdf, accessed 21 October 2021.

[24] https://livingroofs.org/czech-buildings-finance-green-roofs/, accessed 21 October 2021.

[25] Reflecting upon these features, Venter et al. (2021).

[26] Article 92.A MMP, introduced on 5 February 2018 (Diário da República 2018).

inclusion of green roofs appears as a condition for constructions occupying parcels of land above a certain area (Associação Nacional de Coberturas Verdes Barcelona 2021).

Another interesting tool, also already implemented in some cities, is sustainability certification. The Leadership in Energy and Environmental Design (LEED) certification is one of the most popular and is used, in North America, in Chicago, Devens, MA, Boston, Los Angeles, and Vancouver, for instance (Liberalesso et al. 2020).[27] Other examples are "Qualiverde" (Rio de Janeiro) and the Green Building Evaluation Label (GBEL), which is used in China (Liberalesso et al. 2020).

However, before engaging in campaigns to convince society, governments must work with municipalities, as the latter have the power to incorporate such requirements in their MMP. Skilled human resources capable of building the most appropriate BGI solutions for each municipality are also essential. A programme called "Living Roofs and Walls", has been in operation in London since 2008, using a policy based on persuasion, initially motivated by biodiversity enhancement (Mayor of London 2008). As part of its efforts to control rainwater, Copenhagen has been increasing the use of green roofs since 2008, and in 2010 green roofs became mandatory for all new buildings with roof slopes of less than 30 degrees (NYU | LAW 2019). Outside Europe, Toronto was the first city in North America to enact a green roof bylaw and create financial incentives (TORONTO 2019). Meanwhile, the city of Los Angeles chose to implement a programme aimed at large commercial spaces and residential buildings. This public policy encourages the use of these solutions by attaching points to them that can be used when applying for building certification (Department of Regional Planning 2021).

6 Conclusion

Although the current urban planning laws do not yet contain mandatory rules based on environmentally sustainable options, the macro-legislative level is already aware of the importance of urban law to sustainable cities. Portuguese climate law (Law no. 98/2021, 31 December) guides the various social actors towards the reduction of greenhouse gases, carbon neutrality and energy efficiency. It calls upon all administrative bodies, including municipalities, to apply, within their jurisdictions, competences and legal instruments, public policy regarding climate change. Regarding municipalities, they can incorporate BGI solutions in their municipal urbanism regulations to achieve "the sustainable use…of urban spaces" (Art. 28) and the promotion of green space", "with the aim of increasing green coverage and mitigating the heat island effect of urban cent"es" (Art. 57, no. 2). If regulatory solutions at municipal level are flexible, they will allow the adaptation of BGI solutions to specific areas. Despite initially being only incentives, they should gradually become mandatory if they are to be part of an integrated effort to foster nature-based solutions.

[27] https://www.greenroofs.pt/pt/politica/zurique.

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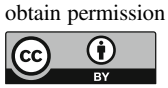

Law and Marine Genetic Resources

Maria Inês Gameiro

Abstract

From a legal perspective, these are exciting times for marine genetic resources (MGR). After years of debate about MGR beyond national jurisdiction, famously encapsulated in the idea of the "deepest of ironies" in ocean affairs, a United Nations process began, focused on drafting an Agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) and with a clear mandate to address MGR. This agreement has the capacity to unravel issues that remain to be solved, particularly when linking MGR with the marine scientific research regime established by the United Nations Convention on the Law of the Sea and with the provisions of the Nagoya Protocol and the TRIPS Agreement, or when addressing MGR under national jurisdiction.

This chapter will consider the web of legal regimes for MGR, including the complexities surrounding marine spaces, such as the extended continental shelf. After providing a comprehensive analysis of both international law—UNCLOS, CBD, the TRIPS Agreement and the upcoming BBNJ Agreement—and national legislation, the chapter will conclude that an all-encompassing approach is required when dealing with MGR.

Keywords

Marine genetic resources · BBNJ · UNCLOS · CBD · TRIPS · Continental shelf

1 Introduction

"Le développement des biotechnologies s'était jusqu'alors déroulé dans une sorte de Far West juridique, dans les interstices du droit de la mer, de l'environnement et de la propriété intellectuelle" (Coutansais 2010, p. 208).

In his work *Mare Liberum*, Hugo Grotius famously stated that "if many hunt on the land or fish in a river, the forest will soon be without game and the river without fish, which is not so in the sea" (Grotius 1916).[1]

This is now known to be untrue and resources depletion is a serious problem in the ocean. But it is also now clear that the variety of resources in the ocean is greater than ever imagined; new species and organisms are being discovered every day, and a significant number of these are microorganisms. Research in this field has led to

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[1] An idea also traditionally associated with Locke (1988). On the natural evolution of marine resources, see Roberts (2007).

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an important finding: the genetic potential of marine resources.

Marine genetic resources (MGR) are "informational biological resources" (Marques 2007, p. 380). As natural resources, they are distinct from classic natural resources such as fisheries, because the value of a genetic resource is not the physical substance in itself but the genetic information of the resource, which means that without technological manipulation, the resource has little or no economic value beyond its obvious intrinsic environmental value and as a component of biodiversity.

The knowledge offered by MGR and their associated potential make them increasingly important in present-day societies. However, legal gaps remain, in areas both beyond and under national jurisdiction. At the international level, the United Nations Convention on the Law of the Sea (UNCLOS, 1982/1994), which created a "new regime for the ocean", does not address genetic resources, despite containing some pertinent provisions on marine scientific research. The Convention on Biological Diversity (CBD, 1992/1993), the related Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Nagoya Protocol, 2010/2014) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement, 1994/1995) also apply, in part, to marine genetic resources. At the national level, many States have not yet outlined legal regimes.

The characteristics associated with marine genetic resources—their location in a fluid environment, sometimes simultaneously in spaces subject to and exempt from national jurisdiction, and the aim of evolving from research to exploration or exploitation—mean that a comprehensive and cohesive legal regime is required. Consequently, negotiations with a view to establishing a legal regime for marine genetic resources are currently taking place at the United Nations. At the same time, at the national level, countries need to address issues of borders and transboundary resources, sovereignty and ownership, access to and sharing of benefits, and intellectual property issues.

2 UNCLOS, CBD, Nagoya Protocol, TRIPS and the New BBNJ Agreement: An Intricate Web of Legal Regimes

2.1 Relevant Treaties and Protocols

The codification and development of the law of the sea received a decisive boost with the adoption of the United Nations Convention on the Law of the Sea, the so called "constitution of the oceans".[2]

The new regime, of unusual magnitude and complexity, introduced numerous innovations, such as the concept of Exclusive Economic Zones (EEZ), changes in the legal definition of the continental shelf, the establishment of a comprehensive regime for marine scientific research, unprecedented rules for environmental protection, and a broad dispute settlement system—including a specialised International Court. It also created the regime of the Area, as common heritage of mankind, as well as an Authority to manage it.

The regime of the Area, corresponding to a space occupying about 30% of the total surface of the planet,[3] is established in Part XI of the Convention and in the Agreement on the implementation of Part XI (1994). It sets out that mineral resources on the seabed and subsoil, i.e. beneath the water column, beyond national jurisdiction, belong to mankind and should be used for the benefit of mankind. Meanwhile, progress in scientific research has made it possible to detect the presence of living resources at great depths and in hostile environments, where

[2] The idea of a "constitution for the oceans" was outlined by Tommy Koh, president of the III Conference of the United Nations on the Law of the Sea, Koh (1985).

[3] The exact size of the Area is dependent on the continental shelf extension processes initiated by several countries (including Portugal).

genetic resources gain prominence as the focus of research and commercial interest.

MGR have significant biotechnological potential (Marques 2007, pp. 25–26),[4] particularly those organisms that survive in environments with extreme pressure, acidity, darkness, temperature, heavy metal concentration or radioactivity. These resources are therefore called extremophiles or hyperthermophiles, or chemosynthetic organisms, because they chemosynthesize rather than photosynthesize.

The isolation of bioactive marine compounds from a Caribbean sponge (*spongouridine* and *spongothymidine*) in the 1950s allowed scientific research to conclude that these had anti-tumour and anti-viral characteristics (Luna 2015, p. 652).[5] Since that time, the relevance of marine genetic resources has grown exponentially and science continues to demonstrate that the potential of these marine resources is vast, especially in the light of health challenges that have now become blatantly clear (Leary et al. 2009). Although they are still undervalued in commercial terms (Pearce and Moran 1994; Ngo et al. 2011; Newman and Cragg 2012), marine compounds are beginning to be developed from deep-sea resources, producing corresponding scientific and economic potential for the marine biotechnology market (Hunt and Vincent 2006).

The Convention on the Law of the Sea employs the terms "natural resources", "non-living" and "living", the latter being biological resources which in general "encompass all resources of or dependent on the sea that can be considered 'living' in UNCLOS terminology" (Dupuy and Vignes 1991, p. 993). It should be noted, however, that several of the UNCLOS living resources provisions explicitly target fish resources and that the concept of living marine resources is dynamic.[6] As such, the application of UNCLOS to marine genetic resources may give rise to some difficulties of interpretation (Dupuy and Vignes 1991; Lawson and Downing 2002; Lallier et al. 2014).

The Convention on Biological Diversity is a positive step towards recognition of sovereignty and the conservation, use, access to and sharing of biological resources, including MGR.

Article 2 of the CBD states that the term "Biological resources" includes "genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity". Biological resources thus include genetic resources, which the same article defines as "genetic material of actual or potential value". The distinction between the two, although the latter is part of the first, is based fundamentally on teleological or functional criteria.

The CBD also defines "biological diversity" (or "biodiversity") as "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (Article 2).

While the UNCLOS to some extent represented a "quantitative" concept of resources, focused mainly on fisheries, the Convention on Biological Diversity recognises the plurality and diversity of resources, including genetic resources.

Despite explicitly recognising the hierarchical superiority of the UNCLOS (Article 22.2 of the CBD), the CBD, a framework convention, and later the Nagoya Protocol, enhanced and added detail to the regime for marine biological resources (including genetic resources), in particular with respect to access and benefit sharing.

Activities related to genetic resources fall along a continuum from scientific research to bioprospecting and commercial development. This distinction has occupied much of the doctrinal work in this area. The CBD's Subsidiary Body on Scientific, Technical and Technological Advice, which has addressed the topic on several

[4] See also Article 2, CBD: "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use".

[5] Esponja *Cryptotheca crypta*.

[6] In terms of commercial use, not so long ago, for instance, dolphins and whales were considered direct food sources.

occasions, clearly describes the fuzzy nature of MGR-related activities:

"While marine scientific research is primarily undertaken with a view to furthering knowledge of the evolutionary relationship between various organisms or of the adaptive mechanisms allowing organisms to thrive in an extreme environment with unique characteristics, some prospective activities are run to discover commercially useful information and resources for subsequent industrial, chemical, agricultural or medical purposes. However, what may have been, in the first place, an expedition with scientific purposes, where intent of economic gain was absent, may result in the genetic resources being transferred to industry for biotechnological applications."[7]

The entry into force of the CBD introduced into the debate the issue of access to MGR and the sharing of benefits arising from them in areas under the jurisdiction of States, which was duly followed by discussions on intellectual property rights over biotechnological innovations (Marques 2007, p. 376).

In this regard, Article 15 is among the most relevant provisions on access to MGR and should be read in the light of Article 3. Article 15 is a clear example of the duality of the Convention, guaranteeing both the sovereignty of States over their genetic resources (paragraph 1) and, simultaneously, the presumption that access to these resources should be provided (paragraph 2). Article 15(2) sets out the CBD's objectives of facilitated access to resources and equitable and fair benefit sharing. The importance of Article 15 is at odds with the absence of a consistent effort to explore the links between this article and Part XIII of the UNCLOS (marine scientific research), with both frameworks creating prior consent obligations that should be articulated. Access to genetic resources is not guaranteed *de jure* but the Convention hints that it should be granted *de facto*, reflecting the attempt to balance sovereignty and access to genetic material (Noiville 1998).

Article 15 emphasises that access is subject to prior informed consent, and is granted on mutually agreed terms. It refers to a duty to seek to involve the Contracting Parties who have supplied genetic resources in any scientific research based on those resources, and also the duty of Contracting Parties to take legislative, administrative or policy measures to bring about a fair and equitable sharing of the results and benefits achieved, with proactivity of States being explicitly called for. The reference to "mutually agreed terms" alludes to a preference for bilateral contracts (Scheiber 1999; Marques 2007, p. 509).[8]

The Nagoya Protocol, adopted at COP 10, seeks to build on the foundations established by Article 15 of the CBD. Its generic formulation is the outcome of difficult negotiations, and distinguishing between genetic and biological resources proved to be complex: for the purposes of the Nagoya Protocol, resources are only biological resources used as genetic resources.

The issue of access is particularly relevant, and one of the challenges is to understand how exactly "access" should be defined and under what circumstances supplier countries are in breach by "denying" access—a particular concern for some countries. Article 6 of the Protocol regulates this aspect, establishing the sovereignty of States over their resources, and defining that access is subject to prior information and consent of the provider country.

The Protocol additionally establishes that benefits arising from the utilization of genetic resources and their applications shall be shared in a fair and equitable way, and on mutually agreed terms, with the provider of the resources (Article 5). Again, this is a concern for some

[7] Subsidiary Body on Scientific, Technical and Technological Advice, *Study of the Relationship between the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea with regard to the Conservation and Sustainable Use of Genetic Resources on the Deep Seabed*, UNEP/CBD/SBSTTA/8/INF/3/Rev.1, 22 February 2003, para. 101.

[8] According to Scheiber the phrase "Access, where granted, shall be on mutually agreed terms" (Article 15(4)) is the central feature of the regime, "the quintessence of the Biodiversity Convention in relation to relevant activities in marine areas in future years".

countries, often those that are "resource-rich" and "technologically-poor". The aforementioned benefits may be monetary or non-monetary, including access to and transfer of technology, and collaboration and cooperation in research and development programs (Article 23). The Nagoya Protocol further details provisions on compliance, monitoring and measures to deal with non-compliance, prior informed consent and mutually agreed terms requisites.

One of the main novelties of the regime introduced by the Protocol was the caveat that Parties must take into consideration the "intention" or "purpose" of the research, reflected in Article 17, pointing to the blurred line between non-commercial and commercial use (Lallier et al. 2014).[9]

The Protocol relates not only to the UNCLOS, but also to the TRIPS Agreement, with the three of them forming the research/exploitation triangle (UNCLOS—CBD/Nagoya—TRIPS) for genetic resources. Intellectual property rights have a direct and effective link with the Protocol, in particular through Article 27 of the TRIPS Agreement, and there has been an in-depth debate on the relationship between these instruments, notably concerning whether or not there is an obligation to disclose the country of origin of the resource when a patent application is submitted.

The debate around MGR, in marine scientific research and bioprospecting, is clearly related to intellectual property.[10]

Intellectual property rights are essentially territorial, and determined by States, although conditioned by applicable international conventions. Thus, whether it relates to marine genetic resources located under national jurisdiction or to those beyond national jurisdiction, intellectual property is regulated by the State where that right is sought, regardless of its origin.[11]

Several patent law dilemmas arise in the debate about genetic resources: the distinction between invention and discovery, the exclusion criteria of public policy, the patentability of living organisms, and the trade-off between patents and plant and species protection (OECD 2002, p. 74). And the current circumstances, in the aftermath of a pandemic outbreak, raise further questions regarding patent law and its role in society. Nevertheless, what is indisputable is that the genes of marine organisms are the subject of an increasing number of patent applications.

The Doha Ministerial Declaration recognised the need to further study the TRIPS Agreement and the CBD, and the Council for TRIPS was mandated to review Article 27(3)(b).[12] The relationship between the TRIPS Agreement and the CBD, including on the important issue of "disclosure", has been the subject of much debate regarding the proper *fora* to address this matter—national legislation, the WTO, the CBD or another forum—but as yet no agreement exists (Plahe et al. 2021).

2.2 The Relevance of the Future BBNJ Agreement

In recent years, one of the stages where this debate has taken place is at the negotiating table for an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

[9] The Protocol allows a two-stage approach, considering precisely the "change of intention": in a first stage, the negotiated agreement may be a "basic research agreement" that can be renegotiated, in a second stage, as a "commercial development agreement", where there is a change not only because a patent has been registered, but because there is a commercial interest arising from the research.

[10] Pisupati et al. (2008): "The grant of a patent in relation to development of biotechnology from marine genetic resources is the key legal act in the bioprospecting process".

[11] One of the consequences of territoriality is the definition by countries of what is patentable, within the limits set by the TRIPS Agreement, meaning that patents are generally applied for in the "research" countries rather than in the "supply" countries, which are often less developed countries where the patentability requirements tend to be more stringent.

[12] Doha Ministerial Declaration, 2001, para. 19.

In 2012, at the United Nations Conference on Sustainable Development (Rio +20), States made a commitment to address "the issue of the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, including by taking a decision on the development of an international instrument under the United Nations Convention on the Law of the Sea", in the document "The Future we Want" (endorsed by General Assembly Resolution 66/288 of 27 July 2012).

This decision was followed by a two-year process, led by a Preparatory Committee (established by Resolution 69/292 adopted on 19 June 2015), after which the United Nations General Assembly adopted Resolution 72/249 (24 December 2017), convening an Intergovernmental Conference (IGC) to develop an international legally binding instrument on marine biodiversity in areas beyond national jurisdiction.

The agreement aims to strengthen the governance framework for areas beyond national jurisdiction, including MGR, and the related sharing of benefits, but also for area-based management tools, environmental impact assessments and capacity-building and the transfer of marine technology.

MGR are among the most complex issues in the BBNJ Agreement. During the negotiations, divisions became visible, mirroring other processes such as that of the Nagoya Protocol, and highlighting the divide between developed and less developed countries, or between the so called "Global North" and "Global South".

Several contentious issues related with the MGR regime persist, including issues of access and the sharing of benefits. The nature of such benefits involves, once again, consideration of monetary and non-monetary benefits (including training and sharing of data, among others) or the removal of this binary divide, on the grounds that non-monetary benefits also carry "costs".

Similarly, there is also the question of commercial vs. scientific research, connected with the major topic of bioprospecting, which raises questions of access to data and intellectual property rights, and requires an understanding on the use of MGR, either for research and development or for exploitation. The connection with the Nagoya Protocol, albeit within different jurisdictions, is evident (Bonfanti and Trevisanut 2011).

3 The Extended Continental Shelf Case: Interconnection Between National and International Law

The regime of the continental shelf and the circumstances of its extension have given rise to an area that, to some extent, can be considered "hybrid": the continental shelf beyond 200 nautical miles. In this instance, there is the need to articulate the powers exercised in an area under national jurisdiction, the outer continental shelf, with an overlying area where there is freedom of the high seas, taking into account that the two spaces are necessarily interconnected. The UNCLOS establishes that the exercise of the rights of the coastal State on the continental shelf must not affect the regime of freedom that exists in the water column (nor in the overlying air space, according to Article 78). However, the coastal State is also entitled to protect its space and resources. The question is thus one of striking a balance, which is not always clear, between the interests of the coastal State and those of the States as beneficiaries of the freedom of the seas (Molenaar 2007; Mossop 2007).

The fact that, in this space, the seabed and subsoil are under the jurisdiction of the coastal State, while the overlying water column belongs to the high seas, marks a real difference from the shelf under the 200-mile limit where, in principle, the water column corresponds to the EEZ of the same coastal State. Although the freedoms of the high seas are not challenged, in principle it is easy to foresee situations where this is *de facto* the case, when navigation or fishing activities, to cite the main examples, affect the activities carried out on the seabed, or vice versa. Furthermore, beyond the 200 miles lay several deep-sea

ecosystems, where the richness of biological resources is vaster.[13]

The interrelationship between different maritime spaces has been confirmed by additional advances in scientific knowledge, and as research intensifies, so does the pressure for and emergence of new economic opportunities. Several States have established delimitation and sharing agreements in this sense, demonstrating through joint development schemes that interconnection is critical (Becker-Weinberg 2014), particularly when considering MGR.

4 Genetic Resources Under National Jurisdiction

The international debate concerning a legal regime for marine genetic resources also arises under national legal frameworks.[14]

MGR often straddle legal and political boundaries. Organisms found within areas of national jurisdiction at some point may later be found beyond areas of national jurisdiction and vice-versa.[15]

National legislation is required to pursue the objectives set forth in the CBD and the Nagoya Protocol, since most of the CBD provisions are not "self-executing", and many depend on "further and eventual densifying legislative activity of the contracting States" (Marques 2007, pp. 404–405). The European Union, for its part, approved Regulation (EU) No 511/2014 of the European Parliament and of the Council of 16 April, on measures relating to user compliance with the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. Following this Regulation, in Portugal Decree-Law 122/2017, of 21 September, was subsequently passed. The Decree-Law addresses several aspects related to the identification, access, use, conservation and sharing of the benefits of MGR.

In addition to the relevant international treaties and agreements, Decree-Law 122/2017 is key to the regulation of MGR, and specifically highlights the potential of MGR located under national jurisdiction (territorial sea, EEZ and the continental shelf) in terms of "scientific research, bioprospecting and exploration/exploitation".

Despite the legal framework in place, a few key issues remain uncertain. The first pertains to access. With different specificities, both the UNCLOS and the CBD are based on a delicate balance between protecting the sovereignty of States and the duty of these States to give, under normal circumstances, their consent to scientific research and access to resources. Since sovereignty over resources belongs to the States where they are located, regulated by national law, the CBD recognises that the "source nations" may also be entitled to the benefits of the resources to which they have ceded access (McLaughlin 2003). Patents on marine genetic resources may therefore include, in addition to the patent holder, the State providing the resource. This principle, allowing benefits to the State of origin of the resources i.e. the "source State", entails some difficulties, as previously stated. The first concerns the non-obligation to disclose the origin of the patented resource. The second relates to transboundary resources and issues of endemism, given that organisms found in different ocean spaces—which also introduces border delimitation implications—have been found to have similar genotypes. This has implications for patents on genetic resources—specifically those located in different national spaces and border areas—and for disclosure requirements.

This is particularly important for Portugal, as a "resource-rich country" where numerous scientific cruises from foreign countries take place (Gonçalves and Gameiro 2018).

In this connection, disclosure issues are also relevant. Portugal, like several other States,

[13] The gap between the reality of biological resources and the strict legal establishment of a vertical dividing line between maritime spaces is also evidenced by the exceptional regime contemplated for sedentary species, such as corals, sponges, mussels, crabs, scallops, or lobsters.

[14] On the potential value of marine genetic resources, see da Silva (2015).

[15] "Oceans and the law of the sea", Report of the Secretary-General – Addendum, Doc. A/62/66/Add.2, cit., para. 189.

defines an obligation of disclosure of origin (through sampling or filing) when it comes to biotechnological inventions. The nature of intellectual property rights makes this a key issue. Indeed, while the obligation of disclosure exists in Portugal, it may not exist in another jurisdiction where a sample collected in Portugal is registered and non-disclosure of the origin of the resource makes it difficult to share any ensuing benefits.

The Nagoya Protocol recommends that Parties create mechanisms to address potential complications, but these are often voluntary, at best. Decree-Law 122/2017 also details monitoring tools, including disclosure of research funding (Article 8), considering the "intent" or "purpose" of the research, i.e. non-commercial or commercial.

Finally, there is the question of geographical divisions. While the legal framework for spaces under national jurisdiction can be considered to be broadly set, despite relevant gaps, the same cannot be said for "hybrid spaces", i.e. the extended continental shelf, particularly considering the high seas regime, and its entailing freedoms on the water column above.

5 Conclusion

The ocean is a physical ecosystem where the law reveals its *plasticity*, promoting a dialogue between different areas, both nationally and internationally, as well as a favourable ground for interaction with other sciences.

Although traditionally dominated by *lege ferenda*, the international community has defined a *lege data* instrument in this field, including a dispute settlement system and a judicial building. However, despite its many achievements, the established regime (and the subsequent instruments) remains at odds with the very specific nature of such a space and particularly, in the case of MGR, the very specific nature of such resources.

The new challenges posed by the discovery of and growing interest in MGR are widening gaps in the established structure of the law of the sea. But they are also opening new fields of inquiry.

There is a clear demand for regimes that address MGR in a comprehensive manner—articulating marine scientific research and bioprospecting, exploration and exploitation, sovereignty, and intellectual property rights, at the international and national levels. However, the path is not a clear one, as evidenced by the BBNJ Agreement negotiations rounds.

The characteristics associated with marine genetic resources—the fact that they have no intrinsic commercial value (despite having ecological value), being dependent on laboratory transformation and a patentability regime that affects them, the legal uncertainty that surrounds them at international and national level, accentuated by the particular environment in which they live (the ocean), with clear differences in relation to the terrestrial environment—result in challenges that a watertight legal approach cannot solve when confronted with the ecological, economic and political realities under development in this field.

And yet, in an area where the interconnectedness between national and international jurisdictions is so evident, an international solution is paramount.

It should be noted that the main concerns raised in relation to MGR have been the same over the last decades. Issues of origin and disclosure were raised in the Doha Declaration of 2001 and are among the most contentious issues of the BBNJ Agreement negotiations, as they were at the Nagoya Protocol negotiations.

The boundaries between scientific research and commercial interests, and the ensuing intellectual property regime and royalties' issues, were the subject of heated debate between 1973 and 1982, during the negotiations for the UNCLOS. These issues remain under scrutiny today.

Despite the different agreements and negotiations currently in existence, a consensus on the BBNJ Agreement will—we believe—unlock the *Gordian knot* of MGR, fostering greater consensus in other *fora*, such as the TRIPS Agreement or national legislation.

This explains the key relevance of the new agreement on the law of the sea, where MGR play a prominent role. Conversely, the international negotiations for an agreement with a clear focus on MGR also highlight the importance of such resources in years to come. The journey appears to be just beginning.

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Marine Bioprospecting: Understanding the Activity and Some Challenges Related to Environmental Protection, Scientific Research, Ethics, and the Law

Maria Bekiari

Abstract

Marine bioprospecting is an activity that has only been developed recently. The term refers to the exploration and commercial exploitation of marine genetic resources. It is a promising but also highly controversial activity, which is expected to experience significant growth in the next decades, offering vast economic and commercial profits. At the same time, it raises several environmental, scientific, ethical, and legal challenges that will need to be addressed. In order to increase understanding about marine bioprospecting and its overall impact, this paper aims to shed more light on the activity and briefly present some of the resulting challenges.

Keywords

Marine bioprospecting · Marine biodiversity · MGR · MSR · Legal framework · Benefit sharing

1 Introduction

Covering almost 70% of the Earth, marine environments have extraordinary ecological, socioeconomic, scientific, cultural, recreational, and aesthetic value. They serve humans in global trade, transportation, tourism, and energy. Furthermore, marine organisms are a source of food for humans and contribute significantly to the health of the planet by absorbing great amounts of carbon dioxide.[1] Technological innovation and developments in marine equipment and laboratory technology have enabled cost-effective exploration and sampling of unexplored areas and sophisticated research on sampled organisms in laboratory settings (Krabbe 2021, p. 25). This evolution has meant that, for the first time in history, it is possible to explore the deep oceans and other previously inaccessible remote and frontier areas, and to extract resources from them (Leary 2007, p. 158ff; Scovazzi 2007, p. 16; Ramirez-Llodra 2020, p. 38ff).[2] Furthermore, advances in science, especially in the fields of marine biology, genomics, oceanography and bioinformatics, have increased understanding about marine organisms (Matz 2002, p. 280f; Arico and Salpin 2005, p. 8; Leary et al. 2009, p. 188; Doussis 2017, p. 87). This technological and scientific development has revealed that, along with their pure scientific value, marine organisms have an extended commercial value. They produce a variety of secondary metabolites

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[1] On the value and services of marine environments, see Farrier and Tucker (2001), p. 221; Barbier (2017), p. R507.

[2] On the history of human presence in the oceans, see Andersen (2020), p. 61.

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that are useful in product development, especially in medicine, agriculture, chemistry, and cosmetics (Leary 2007, p. 158ff; Leary et al. 2009, p. 185).

As a result of recent developments and the increasing commercial interest in marine organisms, new activities have emerged. One of them is Marine Bioprospecting (MB), a promising, yet hotly debated, activity concerning the commercial exploitation of Marine Genetic Resources (MGR).[3] MB has been described as the activity of identifying unique properties of marine organisms for the purpose of product development (Mossop 2015, p. 825). On the one hand, MB is expected to experience significant growth in the next decades, leading to vast economic and commercial profits. On the other hand, it raises several issues regarding environmental protection, scientific research, and equity. The lack of a comprehensive legal framework and the limited experience and systematic knowledge regarding its exercise, possible implications, and long-term consequences complicate things further. Therefore, it is necessary to develop a thorough understanding of MB, define its potential and limitations, and regulate it effectively. This will enable maximum gains to be achieved, while minimising the risks and potential harm associated with its uncontrolled exercise. Within this context, this paper aims to briefly present some challenges connected with the exercise of MB. The first part will explore the activity itself, while the second one will provide an overview of the environmental, scientific, ethical, and legal challenges.

2 Understanding Marine Bioprospecting

This section aims to shed more light on MB by defining it, distinguishing it from Marine Scientific Research (MSR), describing its main characteristics, and presenting its commercial aspect and the interests connected to it.

[3] For more on the history of MB, see Krabbe (2021), p. 58ff.

2.1 Definition of Marine Bioprospecting

Since MB has only recently been developed as an activity, a unified definition of the concept is lacking. In fact, different understandings have been expressed over time regarding the number and kinds of processes that MB covers (Arico and Salpin 2005, p. 15; Leary 2007, p. 157; Hemmings and Rogan-Finnemore 2009, p. 535; Leary et al. 2009, p. 184; Mossop 2015, p. 826; Yu 2020, p. 7; Krabbe 2021, p. 41).

In a narrow sense, MB is defined as the "exploration of biodiversity for commercially valuable genetic and biochemical resources, or the process of gathering information derived from the biosphere, regarding the molecular composition of genetic resources for the development of new commercial products" (Subsidiary Body on Scientific and Technical and Technological Advice 2003, para 49; See also Matz 2002, p. 282; Arico and Salpin 2005, p. 15; de La Fayette 2009, p. 228; Broggiato 2013, p. 248; Mossop 2015, p. 827; Tvedt 2020, p. 245f; Ganashree 2021, p. 199). It includes the access to and exploration of marine environments, the sampling of organisms, and the initial process of scientific investigation and sampling analysis in laboratories. The aim is to indicate biological compounds of actual or potential value to commercial applications (Moran et al. 2001, p. 505; Matz 2002, p. 282; de La Fayette 2009, p. 228; Harvey and Gericke 2011, p. 325). In this sense, MB constitutes the first step towards future commercial exploitation of MGR and ends with the isolation and characterisation of the desired compound or property (UN Secretary General 2007, para 150).

In a broad sense, MB includes in-situ exploration and sampling as well as the entire research and development process. It is defined as the "process whereby commercially useful products are technologically derived, processed and developed based on the collection of marine genetic resources" (Krabbe 2021, p. 41). Here, MB does not cover only the initial process of sampling and laboratory analysis but also the product

development and full-scale commercialisation (Farrier and Tucker 2001, pp. 213, 231; Arico and Salpin 2005, p. 15; Leary 2007, pp. 158, 164f; Leary et al. 2009, p. 184; Wales 2015, p. 46; Krabbe 2021, p. 41ff). It involves a number of actions divided into four stages in a linear sequence: first, the exploration and discovery, which includes the investigation and in-situ collection of samples and data from the environment; second, the isolation, characterisation, and culture of bioactive components in laboratories; third, the screening of components for useful quantities that may result in products; fourth, the full scale commercialisation, which includes patenting, product development, marketing, and selling (Jabour-Green and Nicol 2003, p. 85ff; Leary 2007, p. 164ff; Heafey 2014, p. 496; Bhatia and Chugh 2015, p. 178; Krabbe 2021, pp. 20, 43, 104). In the last stage, the natural component may represent a source of inspiration for the product development or it may be a large part or the whole of the final product. The latter case presupposes the harvesting of large quantities of organisms in bulk (Jabour-Green and Nicol 2003, p. 85; Krabbe 2021, p. 100).

Furthermore, based on a different understanding, bioprospecting describes the initial stage of exploration including sampling in small quantities, while biodiscovery covers the subsequent stage of recollection, isolation, characterisation, culture, screening, product development, and commercialisation (Hemmings and Rogan-Finnemore 2009, p. 536. See also Matz-Lück 2017, p. 1611). Moreover, for some scholars, MB does not only refer to organisms but also includes the associated traditional knowledge. This is usually possessed by indigenous coastal communities and is related to medical and other applications of marine resources and the management of biodiversity (Compare Shiva 2007, p. 307; Demunshi and Chugh 2010, p. 3018; Eritja 2017, p. 225). This knowledge constitutes an essential complement in order to pursue effective research and discover useful properties and applications, especially in case of drug development.

In order to provide a comprehensive understanding of the complexity and inherent challenges of MB, this paper accepts the broad definition. The following analysis has practical value only if the activity is considered within its natural complexity and is not seen only from a theoretical and simplified perspective. Before entering the main analysis, it is necessary to briefly outline three characteristics of MB. First, MB is a highly risky, long-lasting and expensive activity and requires wide-ranging technological and scientific expertise (Farrier and Tucker 2001, p. 227; Krabbe 2021, p. 105). The process between sampling and selling may last up to 15 years. The most costly and burdensome phase is in laboratories (Farrier and Tucker 2001, p. 227; Krabbe 2021, p. 29). Second, exploration and resource extraction take place in areas within and beyond national jurisdiction. However, the main focus in the future is expected to be on some unique and valuable organisms of deep oceans. Third, MB shows a high degree of complexity, diversity of purposes, methods, and processes, and may vary significantly from case to case (Tvedt 2020, p. 246; Krabbe 2021, p. 104). Different needs and practical requirements have led to the development of various means of conducting MB. Furthermore, it is not very common for the whole process to be conducted exclusively by a single entity or bioprospecting group (Krabbe 2021, pp. 30, 104). On the contrary, the current trend is to establish collaborations between scientific and bioprospecting groups or use data collected from other groups. This complexity creates challenges and uncertainties that have to be considered when regulating the activity.

2.2 Marine Bioprospecting VS Marine Scientific Research

Scholarship and praxis are often unclear about the nature of MB and whether it should be considered as MSR. MSR is fundamental research undertaken for purely scientific purposes and carried out with the intention of open publication (Matz 2002, p. 282; de La Fayette 2009, p. 270; Scovazzi 2013, p. 121; Doussis 2017, p. 89). It is described as 'an activity that involves collection

and analysis of information, data or samples aimed at increasing mankind's knowledge of the environment, and is not undertaken with the intent of economic gain' (Scovazzi 2004, p. 401f; See also Leary 2007, p. 183ff).

A comparison between MB and MSR shows that they both relate to the exploration of marine environments and include sampling, laboratory investigation, and research. Furthermore, both focus on the exploration of the same kind of marine organisms and hotspots and make use of similar technologies, research and investigatory methods (Krabbe 2021, p. 198). However, they pursue different purposes (Compare Caflisch and Picard 1978, p. 850; Mossop 2015, p. 832; Matz-Lück 2017, p. 1611; Yu 2020, p. 9). While MB investigates marine organisms in order to develop products and make profit, MSR aims to increase scientific knowledge and understanding for the benefit of humankind. The latter researches marine environments in order to describe and understand oceans, the functions and processes of marine ecosystems, and the role of genetic resources within biological diversity (Matz 2002, p. 283; de La Fayette 2009, p. 270; Krabbe 2021, pp. 49ff, 198).[4] In order to enhance knowledge, MSR is characterised by openness, exchange of samples, and dissemination of data and research outcomes (Scovazzi 2004, p. 402). Although the knowledge produced may later be used in commercial and non-commercial applications, the exclusive goal of MSR is scientific discovery and the expansion of scientific knowledge.

The different purposes pursued by MB and MSR have practical and legal implications. At a practical level, sampling methods, the selection of organisms, and the frequency and intensity of sampling may differ significantly. Sampling in scientific projects usually takes place randomly and in small quantities and the applied methods focus on screening and understanding marine environments. On contrary, sampling in MB projects is often more invasive and manipulative of the environments. It targets exclusively habitats and organisms with increased commercial value, and may occur repeatedly and in large quantities. As a result, the two activities may affect marine organisms and environments on a different scale. Especially when product development in MB requires the intensive harvesting of organisms, there is a higher risk of causing significant and irreversible harm. At the legal level, the different purposes are fundamental in determining the regime that regulates the exploration, sampling, and in-situ research and the conditions for the protection, publication, and use of research data and outcomes (Matz 2002, p. 283; Scovazzi 2004, p. 401, 2020, p. 223; Drankier et al. 2012, p. 416; Yu 2020, p. 6).

Despite the clear lines in theory, the boundaries between MB and MSR are often blurred in praxis as a result of an increasing trend of mutual interaction and integration (Farrier and Tucker 2001, p. 228; Wales 2015, p. 46; Yu 2020, p. 8f; Krabbe 2021, p. 103). This usually happens when a project is partly scientific and partly commercial or when the same data and research outcomes are used in science and for commercial applications. The requirements for scientific and technical expertise and the high costs of sampling and research often give rise to close collaboration between scientific research institutions and bioprospecting groups (Farrier and Tucker 2001, p. 228f; Jabour-Green and Nicol 2003, p. 78; Leary et al. 2009, p. 184; Heafey 2014, p. 496; Harden-Davies 2017, p. 505; Yu 2020, p. 9; Krabbe 2021, p. 107).[5] In some collaborative projects, bioprospecting groups do not participate in sampling, only becoming involved during laboratory research (Krabbe 2021, p. 112). Moreover, it may happen that non-commercially orientated collaborations begin with the aim of describing new species or exploring the biodiversity of a certain region and their outcomes are later used for commercial purposes (Krabbe 2021, p. 108). In other cases, bioprospectors skip the in-situ investigation and use publicly available information and samples collected earlier by scientific and other

[4] More about MSR in Leary (2007), p. 7ff; Broggiato (2013), p. 249; Doussis (2017), p. 87.

[5] On the Arctic, see Hughes and Bridge (2010), p. 15.

bioprospecting groups and preserved in ex-situ collections, databases, and libraries (Hemmings and Rogan-Finnemore 2009, p. 536; Leary et al. 2009, p. 184; Krabbe 2021, pp. 51, 108f). Sometimes, although a project begins as a fundamental research project, commercial motives are added at a later stage, altering its initial character. This often happens after the in-situ operation is completed (Krabbe 2021, p. 103). In the aforementioned cases, the mix of scientific and commercial elements creates confusion about the character and legal qualification of a project and causes uncertainty about the applicable rules.

2.3 The Commercial Aspect of Marine Bioprospecting

Marine environments contain some of the most valuable and biodiverse ecosystems on Earth. While in the past commercially valuable organisms were supposed to live in coastal areas, recent expeditions have discovered new and rare species in deep oceans and especially on hydrothermal vents and cold seeps. These species have developed some unique and commercially valuable genetic and biochemical properties as a response to the extreme conditions of high pressure and temperature, darkness, toxicity, and absence of oxygen (Matz 2002, p. 281; Leary 2007, p. 159ff; Scovazzi 2007, p. 16, 2010, p. 50, 2020, p. 217; de La Fayette 2009, p. 228ff; Matz-Lück 2010, p. 61; Mossop 2015, p. 827; Ramirez-Llodra 2020, p. 37; Krabbe 2021, pp. 26ff, 53ff). Compared with organisms in coastal areas, organisms of deep oceans are genetically, metabolically, physiologically, and taxonomically very diverse (Subsidiary Body on Scientific and Advice 2005: paras 24ff; Leary 2007, p. 159; de La Fayette 2009, p. 228f; Harden-Davies 2017, p. 505; Krabbe 2021, p. 53). Marine biotechnology recognises in them a high potential for developing new products and processes (Compare de La Fayette 2009, p. 231; Leary et al. 2009, p. 189ff; Scovazzi 2010, p. 51; Harvey and Gericke 2011, p. 323f; Scheiber 2011, p. 95; Harden-Davies 2017, p. 506f; Humphries et al. 2020, p. 2). At the moment, a very small percentage of them have been explored. The likelihood of discovering previously undescribed species with commercial value is estimated to be 500 times higher in comparison with terrestrial counterparts (Arrieta et al. 2010, p. 18320; Mossop 2015, p. 827; See also Arico and Salpin 2005, p. 27; Leary et al. 2009, p. 185. See also Krabbe 2021, p. 53f). This increases the interest of the biotechnological industry in commercially exploiting ocean resources (Leary 2007, p. 159; de La Fayette 2009, p. 231).

In this framework, MB constitutes a key activity in the discovery of novel bioactive properties of marine organisms with potential uses for humans. This is expected to foster innovation, solve current social problems, and improve our quality of life. Findings from MB can be used in various industrial and commercial sectors, such as medicine and pharmacology, agriculture and aquaculture, chemistry, manufacturing and the cosmetic industry, as well as in the fields of eco-toxicology, bioremediation, and bio-fuel production (Farrier and Tucker 2001, p. 215f; Arico and Salpin 2005, pp. 20f, 25, 27; Subsidiary Body on Scientific and Advice 2005, para 21; Leary 2007, p. 160; de La Fayette 2009, p. 231; Leary et al. 2009, p. 189f; Arrieta et al. 2010, p. 18320; Scovazzi 2010, p. 52; Broggiato 2013, p. 249; Broggiato et al. 2014, p. 176177; Mossop 2015, p. 828; Wales 2015, p. 44; Papastavridis 2020, p. 585). The significance of MB is reflected in the number of discoveries based on MGR, the number of patents filed to protect these discoveries, and the number of applications developed from biotechnological discoveries. Since 1999, the number of patents originating from MGR has increased 12% per year on average. (Arrieta et al. 2010, p. 18319; See also Arico and Salpin 2005, p. 25; Leary et al. 2009, p. 189; Krabbe 2021, p. 125).

2.4 Interests Connected to Marine Bioprospecting

Besides the interest of the biotechnological industry in commercially exploiting marine organisms

in order to develop new products and foster innovation, several other interests are at play regarding MB.

Human presence and the investigatory and sampling techniques used can harm organisms and endanger biodiversity. This risk is higher in case of the unique and fragile ecosystems of the deep oceans. Coastal states and the international community have a strong environmental interest in protecting marine organisms and conserving biodiversity (Leary et al. 2009, p. 188; Gjerde et al. 2016, p. 47). Along with the establishment of technical and scientific frameworks, strict rules are required in order to control and reduce harmful bioprospecting activities. Although environmental protection does not necessarily imply the total prohibition of MB, this may be indispensable, especially when activities can harm rare and vulnerable species.

Furthermore, the scientific community has a double interest in MB. Firstly, scientists need to collaborate with bioprospectors in order to cover the immense technological, scientific, and financial requirements. Secondly, scientists have a general interest in the applied methods and the research outcomes of MB as a means of increasing understanding about marine environments (Leary et al. 2009, p. 184; Doussis 2017, p. 87f). Beside purely academic purposes, the gained knowledge may have practical applications, helping scientists and decision makers to develop sustainable mechanisms and policies, manage resources effectively, and address climate change and anthropogenic pollution (Doussis 2017, p. 88). However, it should be mentioned that the commercially-oriented outcomes of MB can only partially serve scientists who follow broader, non-commercial purposes. Moreover, the contribution of MB to science is restricted when data and research outcomes remain undisclosed and protected by intellectual property rights (Leary et al. 2009, p. 184; Drankier et al. 2012, p. 396; Krabbe 2021, p. 112).

Along with the industrial sector, the international community and coastal states have increased economic interest in exploiting marine resources. However, technological, financial, and scientific requirements enable only a small number of developed states to conduct MB. At the moment, three states (Germany, Japan, US) control 70% of MGR, while the majority of other states lack access (Arnaud-Haond et al. 2011, p. 1521; Krabbe 2021, p. 124). This fact generates inequalities between rich and poor states regarding the sharing of benefits from the commercial exploitation of MGR.

Finally, in the case of MB within national jurisdiction, several, often contradictory, interests are involved. Interest in MB is related to the freedom of coastal states to decide whether, to what extent, and under which conditions they will permit resource exploitation. This affects the interests of other states, private entities, and the international community in exploiting marine resources. Furthermore, MB may influence other activities and interests, such as tourism, fisheries, transportation, local communities, and indigenous groups. All these interests have to be identified, described, and fairly balanced.

3 Marine Bioprospecting Challenges Related to Environmental Protection, Scientific Research, Ethics, and the Law

MB is a recently emerged and little understood activity that is in the process of development. It is characterised by a high level of complexity and variability, its boundaries and processes are not sufficiently clear, and various interests are connected to it. MB promises to revolutionise the field of biotechnology, yet, at the same time, it raises environmental, scientific, ethical, and legal challenges that will need to be effectively addressed. This section will provide an overview of some of the important challenges.

3.1 Challenges Related to Environmental Protection

In-situ bioprospecting activities can significantly harm marine organisms and their environments in

various ways. One way relates to the adopted investigatory and sampling techniques. Noise, light, and heat from vessels, the movement of submersibles, accidental oil spills, hazardous waste, and ballast water discharge can cause physical and structural harm (de La Fayette 2009, p. 233; Leary et al. 2009, p. 188; Hubert 2011, p. 330; Broggiato 2013, p. 249). In addition, MB often requires the application of invasive, manipulative, and destructive techniques, such as the clearing of fauna for experimental studies, transplantation of fauna between locations, or the placement of instrument packages. The aim of the techniques used is not merely to describe and understand environments and organisms but rather to identify commercially valuable resources.[6]

Collection of marine organisms can also cause harm, especially when this takes place in large quantities. Researching, identifying, and isolating commercially valuable compounds often require the sampling of large quantities for repeated experiments in laboratories. The exact quantity depends on the research purpose (Krabbe 2021, p. 106). Moreover, it is often economically more profitable to harvest resources in large quantities than to produce them synthetically (Jabour-Green and Nicol 2003, p. 108). In addition, massive, intensive, aggressive, and often uncontrolled harvesting for product manufacturing may destroy organisms and their communities (Farrier and Tucker 2001, p. 218f; Arrieta et al. 2010, p. 18321). Harm is also caused by the collection of resources beyond industrial and scientific needs or when large quantities are required for profitable use. Frequent repeated collection in areas with recognised commercial value adds to the harm, as do simultaneous or successive activities in the same area by various scientific and bioprospecting groups. In fact, repetitive harvesting can threaten species even if it is controlled and moderate (Arico and Salpin 2005, p. 22; Warner 2008, p. 416; Arrieta et al. 2010, p. 18321; Mossop 2015, p. 829). In this context, it is worth noting that the environmental impact of in-situ activities is currently assessed in very few projects (Dhillion et al. 2002, p. 492; Leary 2007, p. 190). Finally, in addition to the destructive factors, it is also necessary to consider the increasing pressure caused by other anthropogenic activities that have a cumulative impact on marine environments (de La Fayette 2009, p. 232).[7]

In the aforementioned cases, MB can disturb fauna, harm the target organisms, and cause second order effects, such as changes in water flows, alteration of the community structure, biological contamination, and the introduction of exotic species. Long-term effects, such as alteration or destruction of marine ecosystems, decreases in population, and species extinction are also possible (Arico and Salpin 2005, p. 22; Subsidiary Body on Scientific and Advice 2005, para 27; Leary 2007, p. 189; Matz-Lück 2010, p. 64; Hubert 2011, p. 330; Scheiber 2011, p. 95). The level of harm depends on a number of factors, including the structure of the ecosystems, the specific circumstances of the targeted area (e.g. environmental conditions, level of pollution, other activities), the uniqueness and vulnerability of the sampled organisms, the characteristics of the project, the methods used, and the quantity and frequency of sampling.

The effects of MB are even more significant in the case of organisms in deep oceans. Due to specific environmental conditions, these organisms grow very slowly, have a slow rate of regeneration, and lack the ability to adapt to changes in their environment Some unique forms of life like trenches that form less than 1% of the oceans have evolved over millions of years. (Compare Harden-Davies 2017, p. 506; Humphries et al. 2020, p. 2). Oceanic organisms tend to recover slowly from disturbances and in some cases damage can be irreversible or take a very long time to reverse.[8] Some organisms are unique, live in small communities, and can be found only in one place. Any intervention during MB and the continuous harvesting of large

[6] On harmful research techniques, see Leary (2007), p. 189; Hubert (2011), p. 330.

[7] On anthropogenic impacts in general, see Ramirez-Llodra (2020), p. 49ff.

[8] On the Arctic environment, see De Lucia (2017), p. 238.

amounts can seriously harm them or cause their extinction. The risk is higher for small and rare populations with limited distribution.

In-situ bioprospecting activities constitute a major threat to these organisms and environments. This fact cannot be ignored for the sake of commercial profit. On the contrary, a comprehensive analysis of all risks and long-term effects is required in order to establish the appropriate scientific, technical, and regulatory frameworks that will effectively manage MB, control its impact, and ensure biodiversity conservation and a high level of environmental protection.[9] This is not only in the interest of marine environments. It also benefits MB, given that the activity itself depends on the good condition of marine ecosystems and a future decline of biodiversity will adversely affect it in the long term (Compare Hughes and Bridge 2010, p. 17). Although the effective management of the impacts from MB seems easy in theory, several challenges complicate it in practice. Some of the difficulties include its complexity, the limited experience in the field, the numerous competing interests, the impact of the techniques used on ecosystems and the lack of comprehensive knowledge about this impact. Other challenges are related to the specific conditions of marine environments, the complexity and limited understanding of the marine realm, the connectivity among ecosystems, the characteristics of the collected organisms, the reaction of organisms to human presence and interventions, and the cumulative and long-term effects. Finally, in addition to the challenges mentioned above, the environmental regulatory framework is insufficient and fragmented, there is a lack of effective monitoring and enforcement as well as knowledge gaps, and the cooperation between actors (states and private entities) is limited (Rayfuse and Warner 2008, p. 402; de La Fayette 2009, p. 257; Leary et al. 2009, p. 183; Matz-Lück 2010, p. 67f).

[9] On the risks of MB for biodiversity, see Farrier and Tucker (2001), p. 213.

3.2 Challenges Related to Scientific Research

Research constitutes the most significant part of MB and seeks to reveal commercially valuable properties of marine organisms for product development. In order to protect their economic interests, bioprospectors keep important information and data produced during research strictly confidential. Confidentiality covers a wide spectrum of information regarding marine resources and environments, the geographic origin of the samples, the methods used, the scientific outcomes, the frequency and intensity of sampling, and other details about the project (Compare Leary et al. 2009, p. 184; Scovazzi 2010, p. 52; Arnaud-Haond et al. 2011, p. 1522; Chiarolla 2014, pp. 178, 180f; Mossop 2015, p. 832; Wales 2015, p. 45; Krabbe 2021, p. 117). In many cases, the deposition of specimens to collections is delayed or bypassed in order to meet confidentiality requirements (Hughes and Bridge 2010, p. 16). At the same time, confidentiality affects the freedom of scientific research and deprives academic scientists and policy makers of useful information (Jabour-Green and Nicol 2003, pp. 78, 97ff; Leary and Walton 2010, p. 2; Wales 2015, p. 45). Furthermore, confidentiality may reduce trust and interaction between scientists, who avoid sharing data before licensing arrangements are made. Hence, there are negative consequences for the conducting of research, fostering of cooperation, and production of novel research outcomes (Hughes and Bridge 2010, p. 15f). Moreover, confidentiality impedes precise and comprehensive assessment of the project in question, understanding of its environmental impact, monitoring of its long-term effects, and the collection of experience. This, in turn, complicates the establishment of effective scientific, technical, and legal frameworks to control MB.

In light of the above, the following questions need to be addressed: What are the limits of confidentiality? To what extent does confidentiality really promote innovation when data sharing is hindered (Compare Chiarolla 2014, p. 178)?

Does confidentiality comply with principles of fairness and reciprocity, given that bioprospectors use publicly available data from scientific groups, while they keep their own data strictly confidential? How could transparency of research outcomes and access to information be guaranteed? Based on the answers to these questions, it is necessary to redefine confidentiality with regard to MB and establish a more appropriate framework.

Besides this issue of confidentiality, MB can also harm academic research in another way. Specifically, the current trend whereby governments and investors provide support to commercially significant projects indirectly forces academic researchers to commercialise their work, produce commercially relevant outcomes, and collaborate with industrial partners in order to get sufficient funding. In the long term, this pressure may influence the quality of academic research, lead to shrinking or loss of scientific areas with little commercial value, and affect the production of a more holistic understanding of marine environments (Hughes and Bridge 2010, p. 15). In this respect, it is necessary to increase awareness and take measures to prevent such outcomes.

3.3 Challenges Related to Ethics

As explained above, MB can foster innovation and product development in numerous industrial sectors. Industries and biotechnology companies invest years and millions of USD in research and product development. As the primary goal is the commercial exploitation of marine resources, bioprospectors are willing to bear the costs and risks if a significant profit is guaranteed. Currently, the potential monetary benefits are estimated to be in billions of USD, and this rate should continuously increase (Arnaud-Haond et al. 2011, p. 1521; Mossop 2015, p. 828). Contracts of exclusive access to and exploitation of marine resources, as well as intellectual property rights, provide incentives and foster innovation, research, and product development (Jabour-Green and Nicol 2003, pp. 78, 87; Leary 2007, p. 170ff; Leary et al. 2009, p. 189; Drankier et al. 2012, p. 396; Chiarolla 2014, p. 172; Heafey 2014, p. 511; Bhatia and Chugh 2015, p. 182; Krabbe 2021, p. 116ff; See also Moran et al. 2001, p. 513). Each year, the number of patents derived from MGR is growing at around 12%. Ten countries own 90% of patents on marine genes while the top three own 70% (Arnaud-Haond et al. 2011, p. 1521; Broggiato 2013, p. 248). Based on studies of the records of genetic sequences associated with patents, the majority of MGR belong to a few corporations (Scovazzi 2010, p. 51; Arnaud-Haond et al. 2011, p. 1521; Blasiak et al. 2018, p. 2). One single company (BASF) has registered 47% of all oceanic marine sequences. Although the commercial exploitation of resources has significant monetary benefits, can foster innovation and improve the quality of life, it raises a number of ethical issues.

The first issue relates to the ownership of genetic resources and the right to control and dispose of them (Compare Bhatti et al. 2009, p. 18; de La Fayette 2009, p. 255; Barnes 2010, p. 83; Fedder 2013, p. 71; Ganashree 2021, p. 199). This raises several questions. What does it mean to "own the resources"? What is the scope of ownership? Who is the owner? To what extent are resources capable of being owned? Do ownership and commercialisation foster growth for the benefit of humankind or for a small number of states leaving biodiversity-rich regions financially and environmentally poor (Shiva 2007, pp. 307, 312)? Other questions relate to the rights and obligations of the owner and the practical and environmental implications of recognising ownership. In line with the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD) recognises the right of coastal states to own and utilise genetic resources within their jurisdiction and to grant access (Farrier and Tucker 2001, p. 222; Harvey and Gericke 2011, p. 323f; Mossop 2015, p. 830; Krabbe 2021, p. 326). In the case of ocean resources, the situation is more complicated, given that no state can claim sovereignty rights and neither UNCLOS nor CBD provide specific rules (Compare Jabour-Green and Nicol 2003, pp. 95, 106ff; Scovazzi 2007, p. 18,

2020, p. 218; Matz-Lück 2010, p. 62; Mossop 2015, p. 836; Krabbe 2021, p. 330). Currently, the question is the subject of negotiations under the Biodiversity Beyond National Jurisdiction (BBNJ) agreement, which aims to establish a framework for biodiversity conservation and fair exploitation (Matz-Lück 2010, p. 65; Scovazzi 2010, p. 53, 2020, p. 218ff; Chiarolla 2014, p. 172f; Mossop 2015, p. 830; De Santo et al. 2020, p. 4). In fact, various regulatory regimes are available (Mossop 2015, p. 837f; Ganashree 2021, p. 203).[10] Some states interested in exploiting MGR endorse the right to free access, while others regard ocean resources as common heritage of humankind.

A second issue relates to the sharing of monetary and non-monetary benefits derived from commercial exploitation of MGR. As explained above, only a few states from the developed north have the capacity to conduct MB, while the vast majority have no access (Scovazzi 2007, p. 19; Wales 2015, p. 45; Blasiak et al. 2018, p. 2). Furthermore, the granting of exclusive rights enables corporations to make significant profits using resources and associated traditional knowledge, while excluding indigenous coastal communities from similar use (Shiva 2007, p. 312; Demunshi and Chugh 2010, p. 3017). Ultimately, MB is seen as 'the expropriation of the collective and cumulative innovation' of the indigenous population, which has been used, protected, and conserved for centuries (Shiva 2007, p. 307). This situation perpetuates the gap between rich and poor states, reinforcing inequalities at the expense of developing states. In this respect, issues of fairness arise with regard to benefit sharing (Jabour-Green and Nicol 2003, p. 80; Rosendal 2006, p. 437; Guyomard 2010, p. 31; Jabour 2010, p. 25; Leary and Walton 2010, p. 2; Arnaud-Haond et al. 2011, p. 1521; Harvey and Gericke 2011, p. 325; Heafey 2014, p. 512; Ganashree 2021, p. 200). The CBD and the Nagoya Protocol address inequalities by introducing a system of sharing the benefits from resource exploitation within national jurisdiction (Moran et al. 2001, p. 516f; Drankier et al. 2012, p. 412, 416; Chiarolla 2014, p. 191; Mossop 2015, p. 830; Ganashree 2021, p. 213). However, this regime includes several legislative, contractual, procedural, and practical uncertainties and controversial issues.[11] Regarding oceanic resources, the issue is under negotiation within the framework of the BBNJ agreement (Scovazzi 2007, p. 24, 2020, p. 226ff; Tvedt and Jørem 2013, p. 151; De Santo et al. 2020, p. 4; Tvedt 2020, p. 238; Ganashree 2021, p. 201). Finally, in addition to issues of ownership and benefit sharing, ethical considerations arise with regard to genetic engineering, public safety, and patentability of life forms (Bruce and Bruce 1998; Leary 2007, p. 171; Drankier et al. 2012, p. 388; Chiarolla 2014, p. 175).

3.4 Legal Challenges

The aforementioned challenges and open questions at the environmental, scientific, and ethical level are reflected in the existing legal framework related to MB. As MB is still in its infancy, a unified and well established framework regulating all issues concerning the commercial exploitation of MGR is missing. Depending on the issue in question, several rules are applicable. (Compare Scovazzi 2007, p. 18, 2010, p. 57; de La Fayette 2009, p. 263; Matz-Lück 2010, p. 64; Bhatia and Chugh 2015, p. 180; Krabbe 2021, p. 131). This section does not aim to list the applicable regulatory regimes but rather to highlight the complexity and identify challenges to be addressed promptly in order to establish legal certainty.

As explained, different regimes are applicable in different zones depending on the subject

[10] For a thorough analysis of possible regimes, see Arnaud-Haond et al. (2011), p. 1522; Drankier et al. (2012), p. 375; Fedder (2013), p. 71ff; Tvedt and Jørem (2013), p. 150; Wales (2015), p. 45f; Humphries (2018), p. 544; Scovazzi (2020), p. 218ff.

[11] For an overview of the weaknesses of ABS regimes, see Jabour-Green and Nicol (2003), p. 94ff; Rosendal (2006), p. 439; Bhatti et al. (2009); Fedder (2013), p. 237ff; Bhatia and Chugh (2015), p. 179.

matter, the stage of the process, and the physical location of the resources.[12] These regimes, characterised by complexity, cover general issues without considering the specific characteristics and challenges of MB. They pursue different goals and apply during different stages of the process, simultaneously or successively, complementarily or concurrently (Krabbe 2021, p. 130; See also de La Fayette 2009, p. 234ff; Demunshi and Chugh 2010, p. 3018; Bhatia and Chugh 2015, p. 180; Ganashree 2021, p. 202). Some rules regulate issues related to in-situ research, such as environmental protection and impact assessment, resource management, the rights of coastal states to grant access, and administrative issues of sampling permissions. Other rules concern contractual issues in the case of research collaborations and funding, the code of conduct for responsible research, acceptable scientific methods, the conditions for ex-situ access to resources preserved in libraries, and the sharing of data and research outcomes. Other rules relate to the use of MGR, benefit sharing, biotechnology issues, intellectual property rights, marketing and product commercialisation.

Application of the appropriate rules presupposes the correct ad hoc legal qualification. However, this may be difficult given the complexity of MB, the various forms it may take, and the blurred boundaries. For example, the relationship between MB and MSR raises questions as to whether MB should be legally treated as MSR (Scovazzi 2007, p. 18, 2010, p. 57f, 2020, p. 223f; de La Fayette 2009, pp. 254, 260ff; Drankier et al. 2012, p. 416; Heafey 2014, p. 509; Mossop 2015, p. 832ff; Matz-Lück 2017, p. 1611; Yu 2020, p. 9; Krabbe 2021, p. 198ff). The situation is more complex in the case of collaborations between bioprospecting and scientific groups or when bioprospectors use data produced in academia (Farrier and Tucker 2001, p. 229f; Matz 2002, p. 283; Guyomard 2010, p. 36f). Qualification issues also arise during laboratory research. In some cases, sophisticated genetic engineering technology modifies the natural components in a way that the final function differs from the original one. In this respect, it is unclear whether this process and the resulting product constitute MB or purely synthetic development (Krabbe 2021, p. 110).

In addition, it is common for different international, regional, and national regulatory frameworks to apply to the same legal issue. These frameworks lack a holistic approach, coordination, harmonisation and normative consistency, and cause confusion and legal uncertainty. For instance, issues regarding patentability or confidentiality are regulated differently within domestic patent law and at international level.[13] Similarly, several international, regional, and national environmental rules may apply simultaneously in a certain area, introducing different conditions on all or some activities. The fact that most of the time the applicable rules are not harmonised leads to problems during implementation, challenging their effectiveness and reducing environmental protection. Furthermore, identifying the applicable regime is often complicated when bioprospecting activities transcend the conventional UNCLOS division in maritime zones and take place partly beyond and partly within the national jurisdiction of one or more states.

Moreover, rules applicable to MB are characterised by a high level of fragmentation, complexity and incoherence, with ambiguities and disconnection, in addition to overlapping rules and legal gaps (de La Fayette 2009, p. 253; Gjerde et al. 2016, p. 47).[14] These characteristics result from ideological differences (different values and goals) and different logics across the regimes, lack of coordination during drafting, and

[12] For an overview of the different legal frameworks, see Drankier et al. (2012), p. 377ff; Heafey (2014), p. 497ff; Mossop (2015), p. 833ff; Gjerde et al. (2016), p. 49; Humphries (2018), p. 542; Krabbe (2021), p. 130ff. See also Warner (2008), p. 411; Drankier et al. (2012), p. 377ff.

[13] More on this issue in Leary (2007), p. 172; Drankier et al. (2012), p. 386ff; Chiarolla (2014), p. 174ff; Heafey (2014), p. 513.

[14] On the reasons of fragmentation and the legal challenges connected to fragmentation and inconsistency, Long (2010), p. 198; Krabbe (2021), p. 37.

regulatory gaps in science and technology.[15] For instance, while resource management, biodiversity protection and benefit sharing for resources within national jurisdiction are regulated under the CBD and the Nagoya Protocol, there is currently no similar framework for ocean resources (Chiarolla 2014, p. 191; For further information, see Matz 2002, p. 285). In these cases, it is very common for disputes to arise as to which rules and legal principles are applicable (de La Fayette 2009, p. 253). Furthermore, in sui-generis regimes like Antarctica and Arctic, the legal framework is more complex and the available regimes are inadequate to respond to the specific needs and requirements (More in Jabour-Green and Nicol 2003, p. 77ff; Guyomard 2010, p. 31; Jabour 2010, p. 19; Mossop 2015, p. 840; Eritja 2017, p. 229ff). Moreover, simultaneously applied regulations that serve different goals may introduce competing obligations and conditions, creating conflicts of rules. Such conflicts exist between patent law and environmental law with regard to confidentiality (Wales 2015, p. 45). While the former promotes confidentiality of information until patents are granted, the latter encourages transparency and free access to data as a means of promoting knowledge and environmental protection (Rosendal 2006, p. 436; Chiarolla 2014, p. 108f; Wales 2015, p. 45).[16] In addition, various regulatory regimes introduce seemingly incoherent obligations, although they are part of international law (Compare Krabbe 2021, p. 271).

The aforementioned characteristics of the legal framework related to MB make it difficult to identify the applicable rules, create conflicts of rules and confusion, and jeopardise legal certainty. In addition to these, two more parameters should be considered. Firstly, the characteristics of marine organisms and environments complicate the establishment of a suitable regulatory framework. Secondly, science and technology in the marine sector are developing so rapidly that legislators are unable to keep pace (Tladi 2019, p. 490f).

Besides challenges at the regulatory level, problems emerge regarding effective enforcement and monitoring.[17] In the case of international agreements and non-legally binding frameworks, their effective implementation depends mainly on the willingness of the state. In addition, enforcement gaps result from the lack of effective compliance and enforcement mechanisms and the lack of standing of states and organisms to protect the interests of the international community (Rayfuse 2010, p. 189). Moreover, rules in international law do not usually impose obligations on private entities and cannot be implemented and enforced in relation to them. At the same time, states are not always able to effectively control them (Rayfuse 2010, p. 189; Tvedt 2020, p. 247). Furthermore, effective implementation depends on scientific evaluations resulting from a thorough analysis of MB. However, this is not always feasible due to the limited experience and available information. Besides, rules often introduce obligations qualified by phrases such as "as far as possible" or "where applicable" (e.g. Article 6 (b), 7 and 8 CBD. See also Mossop 2015). This offers room for manoeuvre, allowing states and corporations to undermine significant obligations. Due to the lack of harmonisation, the implementation of one rule may undermine obligations introduced in other rules. Finally, the multiplicity of regimes, the regulatory gaps, and the conflicting obligations give states and companies a certain discretion to implement rules selectively, or control the system, avoiding to apply of the prohibitive rules of one regime by referring to the permissive rules of another (Krabbe 2021, p. 19).

[15] For a thorough analysis of the different concepts in the law of the sea, environmental law, and patent law, see Krabbe (2021), p. 130ff; See also Ganashree (2021), p. 202ff.

[16] On the relationship between CBD and intellectual property rights, see Krabbe (2021), p. 349ff; See also Drankier et al. (2012), p. 412; On the failure of CBD to address intellectual property rights, see Leary (2007), p. 174.

[17] In general about enforcement gaps, see Rayfuse (2010), p. 169.

4 Conclusion

MB is a relatively new activity and a product of recent biotechnological and scientific advances. It is a promising and challenging activity. On the one hand, it can contribute to improving the quality of life through the development of products and applications. On the other hand, it can cause detrimental and irreparable damage to marine environments, adversely affect scientific research, and increase inequalities. At the same time, the available regulatory framework is characterised by a high level of fragmentation, complexity, ambiguities, and disconnection that hinder proper control of the activity and its impacts.

In order to gain maximum advantage in the long term and mitigate the detriments of MB, it is necessary to become aware of the overall impact of this activity and take measures accordingly. The first step is to understand MB thoroughly. This involves considering it holistically at two levels. At micro-level, it is essential to analyse all challenges and open questions arising from its exercise. Some of these have been briefly presented in this paper. At macro-level, it is necessary to regard MB as part of a big picture that includes other activities and anthropogenic factors, the current state of the marine environment, the needs of current and future generations, and the requirements for biodiversity conservation and environmental protection. Based on the results of this analysis, a comprehensive regulatory framework should be established. This should introduce strict conditions that prioritise environmental protection and ensure the right balance between the interests of all stakeholders. However, given that MB is a complex and dynamic activity, mere regulation is not sufficient. It is also necessary to establish institutions and groups of experts who will be tasked with continuously monitoring the activity and its impacts and ensuring effective implementation of the regulatory framework, in addition to adapting the latter to specific needs and conditions.

Like every other human activity, MB has the potential to affect humans and the natural environment in a positive or negative way. It is in the hands of the current generation to define the footprint that it will leave for humans and our planet. Biodiversity conservation and environmental protection are of critical importance in order to meet the needs of present and future generations. All decisions should be taken on this basis.

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Biotechnological Patents, Compulsory Licensing and SARS-COV-2 in a Pandemic and Epidemic Context

J. P. Remédio Marques

Abstract

The advent of epidemics and pandemics—especially the COVID-19 virus pandemic—calls for a reflection on the social utility of patent law (and supplementary protection certificates for medicinal products) in stimulating research and development of new therapies over the course of time. These incentives, which belong to the legal subsystem of industrial property rights, are articulated with and compete with incentives for the introduction of innovative biotechnological medicines coming from the legal framework on pharmaceutical regulation, with regard to the manufacture and placing on the market of medicines and medical devices (marketing authorisation procedures). On the other hand, several legal alternatives to patent law are envisaged in order to stimulate biotechnological innovation in the medical sector. This paper seeks to highlight some "strengths" and "weaknesses" in the articulation between these legal subsystems, in addition to proposing some solutions and means of achieving consensus.

Keywords

Patent rights · Supplementary protection certificates · Biotechnology inventions · Pharmaceutical regulation of medicines · Compulsory licences; COVID-19

1 Introduction

The current global public health crisis caused by the new *Coronavirus* has revealed a shortage of vaccines, active substances, excipients and other treatments and materials—especially in the context of *biotechnological innovations*—required to tackle the pandemic's effects on individual health and on healthcare provision in general. The various vaccines developed since the beginning of January 2020 currently benefit from *exceptional manufacturing and marketing authorisations* in all Member States of the European Union (and also in non-members).

The *flexibilities* of the TRIPS Agreement, particularly the right to grant compulsory licences for the use of patented inventions, have been hailed as the panacea for the problem of coronavirus vaccine shortages. The improvement of second generation *genetically recombinant vaccines* designed to prevent the entry of the viral protein (*spike protein*) into human cells is currently being studied and developed. However, upstream of this complex legal issue, there are a whole set of constraints in terms of pharmaceutical regulation,

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access to secret know-how, manufacturing and distribution chains for vaccines and other raw materials.

Most of the Covid-19 vaccines, however, are not yet protected by patent rights. Only those developed in the Russian Federation were granted patent rights in a very short space of time (about 2 months from the filing date), and these patents are thus in force in that country. It is assumed that by the end of the 12-month period[1] following the date of filing of the first application, the holders of these patent rights will have filed identical applications for protection at the European Patent Office and the US Patent and Trademark Office, as well as at similar public bodies in Japan, the People's Republic of China, South Korea, Israel, etc. Meanwhile, other pharmaceutical products used in the fight against this pandemic already enjoy patent rights, and in some other cases the patents have already expired.[2]

2 Biotechnological Inventions and Patent Rights

Patent law protects *inventions*. Inventions are *creations of the human spirit* that translate into *technical solutions* (that are new and involve an inventive step) for multiple technical problems, which imply human manipulation of natural forces (e.g., chemistry, mechanics, thermodynamics, electromagnetism), albeit with the help of machines or computer programs, including those provided with artificial intelligence.

In the legal framework of biotechnological inventions, the European Union legal rules are (to date) the only ones that define the concept of "life" in patent law, along with the legal systems of the Member States that have transposed Directive 98/44/EC into domestic law; in other words, the European Union legal system is the only one on the planet that defines the concept of biological material, for the purposes of patent law. In Art. 2(1)(a) of Directive 98/44/EC, of 6 July 1998, of the European Parliament and of the Council, on the legal protection of biotechnological inventions (in *Official Journal of the European Communities*, no. L 213, of 07/30/1998, p. 13 ff.), biological matter is defined as "any matter containing genetic information and capable of reproducing itself or being reproduced in a biological system". The Portuguese Industrial Property Code of 2018 accepted this definition, *qua tale*, in its Art. 54(4).

It should be noted that this definition avoids the use of the word "life" or "organism" or even "living organism". This option seems to be justified by the need to ensure that the concept of biological matter is not limited only to materials that produce energy and that grow and divide, which would exclude viruses from the list. A criterion was thus adopted (a criterion of "life") that highlights the capacity for replication and expression of transmissible genetic information (Marques 2007a, p. 228). As can be seen, this notion of "biological matter"—conceived in the mid-1980s—is now somewhat outdated, as a consequence of the development of scientific knowledge. For example, it only covers (biological) materials that can be replicated or that can self-replicate in a biological system (and not, e.g., viruses, which replicate DNA outside cells and cellular systems equipped with membranes designed to isolate proteins and nucleic acids from the outside environment, with replication of DNA *in vitro*, in a "test tube").

The creativity underlying *cultural goods* protected by copyright—which do not require a constitutive registration system—, unlike the creativity underlying the manipulation of the forces of nature (and, *pour cause*, of genomes) and the *utilitarian approach* that emerges from them as necessary to satisfy human needs materialised in products or processes, allows us to understand why the latter subsystem of intellectual property—i.e., patent law and patentable genetic

[1] Article 4-C) 1) of the Paris Convention for the Protection of Industrial Property.

[2] For example, we may refer to patent rights related to certain processes for the preparation or synthesis of *Ivermectin*. Another example is found in the international patent application WO 2017/049060 A1, filed on behalf of *Gilead Sciences*, which contains claims generically directed to the use of *Remdesivir* in infections caused by viruses of the Coronaviridae family, to which coronaviruses belong.

realities—resonates less, in ethical and legal terms, among consumers of products and processes that are protected by this patent law. Despite much national and supranational controversy surrounding the limits placed on access to health care by the rules governing medicine patents, and despite criticism of the specific rules on the patentability of elements detached from the human body (including genes) and animals, and how these affect access to plant reproduction or plant propagation materials—in particular, seeds—, these industrial property rights have not been part of the cultural life of citizens or organisations representing their interests in these areas of human action (Marques 2021, p. 161).

These inventions may have biological materials as their object: e.g., genetic sequences (DNA, RNA), bacteria, viruses, cells, cell lines, and animal and plant parts. And these biotechnological inventions and the patent rights attached to them are at the forefront, domestically and in international trade, of current and future controversies over people's access to health care and of States' aspirations to improve their public health systems, in terms of the acquisition and supply of medicines to their citizens.

It is my opinion, however, that the issue of providing patent protection for certain *biological realities*, and in particular genetic sequences—including the genetic sequences of human beings–, and of protecting pharmacological, preclinical and clinical information transmitted by drugs companies when applying for approval for generic medicines, places the patent right, the legal rules on plant varieties and the exclusive rights over that test data at a new juncture, namely, the economic enjoyment of this type of industrial property rights and economic analysis of the markets created by the presence of the biological realities thus protected, on the one hand, and the *cultural and social sense* of the use and consumption of the products and processes protected by these rights, on the other. Quite often the same biological reality (e.g., a plant or part of a plant) constitutes the mass where two types of exclusive industrial rights—the biotechnological patent right and the *plant variety breeder's right*—can converge, with a potential serious conflict regarding their protection, particularly if the holders of those rights are different persons or entities.

Directive 98/44/EC, of the European Parliament and of the Council, of 6 July 1998, on the legal protection of biotechnological inventions, determines, in its Article 5 that: "1. The human body, at the various stages of its formation and development, and the simple discovery of one of its elements, including the sequence or partial sequence of a gene, cannot constitute patentable inventions. 2. An element isolated from the human body or otherwise produced by means of a technical process, including the sequence or partial sequence of a gene, may constitute a patentable invention, even if the structure of that element is identical to that of a natural element".

Article 4 states that; "1. The following shall not be patentable: (a) plant and animal varieties; (b) essentially biological processes for the production of plants or animals. 2. Inventions which concern plants or animals shall be patentable if the technical feasibility of the invention is not confined to a particular plant or animal variety. 3. Paragraph 1(b) shall be without prejudice to the patentability of inventions which concern a microbiological or other technical process or a product obtained by means of such a process".

The protection of inventions concerning sequences of genes, cells, animals and plants — including human genetic sequences previously detached from the human body — has provoked immense controversy and concern, and has been the focus of several misunderstandings and some facts that are difficult to refute (Marques 2001, p. 21 et seq.; Burk 2013, p. 747). We may consider the issue of the patentability of cell lines derived from totipotent cells of human embryos: concerning the "bioethical clause" contained in the European Patent Convention (Art. 53(a)), in decision G 0002/06, of 25/11/2008 (*use of embryos/Warf*), the Enlarged Board of Appeal ruled that such lines were not patentable, since, although totipotent cells had not been claimed, the making of the invention, as described, involved the destruction of embryos. More recently, the Technical Board of Appeal reiterated

this decision, in Decision T 2221/10, of 4/2/2014 (*Culturing stem cells/ TECHNION*).

With regard to plant varieties (which enjoy their own industrial exclusivity through a *Plant Variety Right* based on the *Convention for the Protection of New Plant Varieties* of 1961 (Neumeier 1990, p. 13 et seq.; Wuesthoff et al. 1999, pp. 95–112; Mills 2005, p. 139 et seq.; Marques 2007b, pp. 98–134; Metzger and Zech 2021, section 3), in the European Union the legal rules on patent rights allow for the protection of inventions if the *technical feasibility of the invention is not confined to a particular plant variety*, or in cases that are not essentially biological processes for the production of plants.

3 Patent Rights and Access to Medicines (e.g. Vaccines). Pre-existing Patent Rights and Supplementary Protection Certificates for Medicinal Products; Patent Applications and Patent Rights Not Yet Granted

The vast majority of vaccine-related (product or process) inventions are currently the subject of patent applications. In some cases the patentability procedures for these have already allowed the applications to be published, although the patent rights have not yet been granted. This is because, as a rule, patent applications are published 18 months after the application for protection.[3] Hence, most of these patent rights applications were only published in the second half of 2021. In the future, this situation will probably be repeated as a result of the successive changes that will need to be made to the vaccines patented in the meantime, due to the mutations that the virus will periodically undergo.

These patent applications generally include claims directed to:

- vectors containing the nucleic acid of the virus;
- cells and pharmaceutical compositions containing the virus;
- antibodies (monoclonal) intended to recognise the viral protein;
- *in vitro* viral infection diagnostic methods;
- modified genetic sequences of the viral protein (in vaccines developed by *Moderna* and *Pfizer*);
- the use of the virus as a vaccine to prevent or treat infection.

On the other hand, some medicines (e.g., vaccines) may be protected by various patent rights (e.g., for chemical intermediates, starting materials, chemical or biotechnological synthesis process(es), pharmaceutical formulation, etc.), which, in compliance with the principle of unity of invention (Article 73 of the Portuguese Industrial Property Code; Article 82 of the European Patent Convention), may be the subject of several patent applications or *divisional applications*.

There is, however, a set of patent rights that were granted in the recent past concerning other coronaviruses. This is, for example, the case of European Patent (EP) 3 172 319 B1, applied for on 07/23/2015 (also for Portugal) and granted on 11/20/2019, EP 2 898 067 B1, applied for on 23/09/2013 and granted on 15/01/2020 (of the same sort designated to be in force in Portugal), and US patent US 7,220,852 B1, which was filed on 04/12/2004 and granted on 05/22/2007.

It is known that *Pfizer* and *BioNTech*, *Moderna* and *AstraZeneca* have entered into patent rights (sub)licence agreements concerning several patents—relating to methods of acting on the messenger RNA (mRNA) of segments of the viral protein—that have been held by the University of Pennsylvania since 2005 (Abinader 2020; Le Péchon-Joubert and Carlyne 2021).

[3] Article 93 of the European Patent Convention; Article 69(2) of the Portuguese Industrial Property Code (2018).

4 The Issue of Access to Test and Clinical Data (Pharmacological, Toxicological, Preclinical and Clinical Data) and Generic Medicines. Exceptional Marketing Authorisations (For Reasons of Public Interest) for the Placing of Vaccines Against COVID-19 on the Market

In any case, most of the (product and process) inventions concerning vaccines have already been granted (exceptional) manufacturing and marketing authorisations by administrative health authorities (e.g., the *European Medicines Agency*; the Hungarian health agency for certain vaccines from China, and the Russian Federation). However, as far as patentability procedures are concerned, these inventions are still in the (formal and substantial) examination phase of protection applications.

In fact, the issue of an administrative authorisation for a medicinal product to be placed on the market for human use does not usually occur prior to the granting of the patent rights underlying the technological innovations that that medicinal product incorporates; indeed, the opposite is almost always the case. However, the public health emergency that States are experiencing has reversed the normal order of things. This has given rise to the unusual situation of granting authorisation to place the medicines on the market before granting patent rights on those medicines, through the issue of *exceptional authorisations* (for reasons of public interest) for the placing of vaccines against COVID-19 on the Market.[4]

In addition to the above, many medicines are protected (and will be protected) by means of a *supplementary protection certificate* (SPC).[5] The SPC—which lasts for a maximum period of *five years*, and can be extended for an additional period of *six mont*hs when it concerns medicinal products for paediatric use (including vaccines)—becomes effective from the expiry of the patent rights relating to the reference medicinal product which has previously received authorisation to be placed on the market.

However, the current legal regime on the compulsory licensing of pharmaceuticals protected by patent rights can only affect *patent rights* and not *supplementary protection certificates* (that have already been granted or are already in force). Moreover, there are numerous medicines whose patent rights have already expired that benefit from this separate protection right (although it is instrumentally linked to the basic patent right where the active substance or composition of active substances that is part of the medicinal product subject to the Marketing Authorisation is mentioned—i.e., in the claims or description), where the object of that right is the reference drug to which the Marketing Authorisation was granted.

In any case, even if this legal framework is changed—in the sense of expressly enshrining the possibility of granting compulsory licences for pharmaceutical products that are the object of patent applications—the issue of access to data on pharmacological, toxicological, and preclinical tests and trials still remains. This data was generated by the company that obtained the marketing authorisation to place the reference drug on

[4] Article 22 of Directive 2001/83/EC, of the European Parliament and of the Council, of 6 November 2001, on the Community code relating to medicinal products for human use; exceptional authorisation which is based on one of the causes referred to in Part 4 (G) of Annex I of this Directive. When a marketing authorisation application is submitted for a product which is of major public health interest, in particular from the viewpoint of therapeutic innovation, the applicant may request an accelerated assessment procedure in accordance with Article 14(9) of Regulation (EC) 726/2004, of the European Parliament and of the Council, of 31 March 2004, laying down Community procedures for the authorisation and supervision of medicinal products for human and veterinary use and establishing a *European Medicines Agency*. In Portugal, see, also, the current wording of Article 92 of Decree-Law No. 176/2006, of August 30, on the legal framework for Medicinal Products for Human Use.

[5] See Regulation (EC) No 469/2009, of the European Parliament and of the Council, of 6 May 2009, concerning the supplementary protection certificate for medicinal products.

the market, which is, as a rule, the holder or licensee of the patent rights. The method that enables the chemical (biotechnological) and pharmaceutical invention to be produced in a safe and effective way by the beneficiaries of those compulsory licences is indispensable and requires access to such *test* data.

However, on the one hand, this test data is protected by a *sui generis* trade secret regime that binds the health authorities that approve such medicines in terms of their safety, efficacy and quality. In the European Union, this legal framework lasts for at least *8 years* from the issue of the marketing authorisation. On the other hand, the marketing authorisation of the reference drug—even if the drug is not the object of any patent rights or patent applications, or the potential patent has been judicially invalidated or has been waived by the patent holder—, as previously stated, grants its holder *exclusive marketing rights* for that medicinal product for a period of *10 to 12 years* from the date on which the marketing authorisation is issued.

This situation imposes, de *iure condendo*, the possibility of providing for a specific legal permission for the competent health authorities to use this test and trial data to approve generic medicines (manufactured under compulsory patent rights licences or compulsory patent application licences); and, in addition, these administrative bodies are authorised to provide such scientific data to the beneficiaries of these compulsory licences under strict confidentiality conditions, in order for them to demonstrate the bioequivalence—*et pour cause*, the safety and efficacy—of the generic medicines used in the treatment of this viral infection, with the primary aim of being, themselves, generic medicines approved on the basis of a public health emergency.

Access to such test data in these public health emergency situations will need to operate on the basis of a stand-alone compulsory licence or, alternatively, be integrated within the compulsory licence of the product that is the object of a patent application (or of the product subject to patent rights, if these have already been granted). Evidently, in calculating the financial (or other) compensation to be allocated to the patent holder or to the patent applicant that holds the test and clinical data, the economic value of this data will have to be computed (Marques 2008a, pp. 233, 234; Marques 2008c, p. 211; Marques and Fernandes 2013, pp. 547, 548), and the extent of the legal power that a reference medicine marketing authorisation holder has to oppose the marketing, by third parties who are beneficiaries of the compulsory licence, of the corresponding generic medicines within a period of *10 years* from the date of issue of that marketing authorisation.

Finally, one important point to remember is that the manufacture and marketing of medicines (*in casu*, vaccines)—even when partially achieved with the use of subsidies from the European Union and/or its Member States—is highly dependent on the content of the multiple distributions agreements concluded between the Member States (or the European Commission on behalf of the European Union) and pharmaceutical companies (some of them based outside the *European Economic Area)*, namely the timeliness of deliveries, the price per unit, the forms of payment, the penal clauses foreseen in the event of delay or definitive non-compliance, the clauses to be inserted in contracts concluded downstream intended to allow the manufacture and adequate distribution of medicines and other devices, the law applicable to the merits of the case, the international jurisdiction for the competent court award, etc. Moreover, the marketing will also depend on the availability of certain types of biological and non-biological materials used in the manufacture of some vaccines, which are widely known to be in short supply.

5 Compulsory Licensing of Patent Rights and Biotechnological Patented Medicines

The original text of the *Paris Convention for the Protection of Industrial Property*, adopted in 1883, imposed an obligation on the patent holder to use the patent rights, and the Washington

Revision (of 1911) established a sanction for non-compliance. Hence, this provision created a legal duty for the patent holder and failure to comply could give rise to expiry of the patent (Marques 2009, p. 184).

Article 5 of the Paris Convention already provided for the possibility of issuing a compulsory licence due to lack of exploitation of the object of the patent. In fact, after the Hague Review (1925), the *Paris Convention* began to provide for the possibility of granting compulsory licences and, *ultima ratio*, for the expiry of the patent if it was not being commercially exploited.

In Portugal, the compulsory licensing of patent rights for reasons of *public interest* was introduced from the outset in the Industrial Property Code of 1940. In fact, the Portuguese legislator transposed compulsory licensing in Article 30(1) of the Code. The issue of this compulsory licence was possible provided one of the following conditions was met: the patent holder had not exploited the patent, without just cause, directly or through a licensee, for a period of *three years* following its granting, or, in the case of it having been exploited, such exploitation had then ceased for three consecutive years. Furthermore, the 1940 Code also provided for compulsory licensing in respect of dependent patents (dominant patent *versus* dependent patent).

Article 30 of the TRIPS Agreement allows Contracting States to "provide limited exceptions to the exclusive rights conferred by a patent, provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties". These exceptions are the free use of patented products or processes beyond the *intrinsic limits* of the patent right, allowing for a return to the sphere of freedom, previously hindered by the industrial property rules, provided that certain requirements are observed.

Article 31 of the same Agreement establishes, in addition, the minimum legal rules for the issue of compulsory licences and extends the possibility of their use to cases of *national emergency*—this in addition to public use and cases of dependent patents, which were already included in the Paris Convention. Subparagraph *b)* of Article 31 also provides for the need to first make efforts to obtain a voluntary licence under reasonable commercial conditions. Compulsory licences will only be issued if such efforts have been unsuccessful within a reasonable timeframe. There is also a requirement to pay adequate remuneration in the circumstances of each case, taking into account the economic value of the licence, as well as a requirement that decisions be subject to judicial or other independent review by a distinct higher authority. The new Article 31*bis* of the TRIPS Agreement—following the *Doha Declaration* of November 2011 on the TRIPS Agreement and public health—provides for the possibility of issuing compulsory licences for the manufacture of pharmaceutical products in a Contracting State primarily intended for export to one or more Contracting States with serious public health problems, in other words, to the extent necessary for the purposes of producing a pharmaceutical product and its export to an eligible importing Member in accordance with the terms set out in paragraph 2 of the Annex to the Agreement.

However, the requirement of *prior negotiation* may be waived by the domestic laws of the Contracting States in the event of a *national emergency*, in a situation of *extreme urgency* or in the case of *non-commercial public interest*. It should be noted, however, that Portugal has not yet amended the Industrial Property Code of 2018, in order to provide for this exemption from the need for *prior negotiations* for reasons of public interest generated by a situation of extreme urgency (e.g., a public health emergency).

Compulsory (or non-voluntary) licences granted for products subject to patent rights emanate from *administrative acts* that remove some of the property rights from the rights-holder, embodied in *heteronomous constitutive public authorisations*, whereby the beneficiary of the compulsory licence (human person, legal entity, public entity or the Government itself) will be able, without the agreement of the holder of the patent rights, to exercise all or some of the legal

rights included in the respective document (e.g., offer, import, manufacture, marketing, etc., of the products protected by the patent rights or execution of the processes protected by it), in line with the conditions of exploitation imposed by the said administrative body (Marques 2008b; Fidalgo 2015, p. 61).

Considering the need to adequately fight the SARS-CoV-2 pandemic, as well as the current (and future) mutations that coronaviruses may suffer and the possible epidemics arising therefrom, the possibility of granting a compulsory licence can certainly be justified for reasons of *public interest*, particularly when the exploitation of the invention is of "primary importance" for public health. This compulsory licence may relate, for example, to the manufacture and distribution (including the import) of diagnostic methods, anti-inflammatory medicines, monoclonal antibodies, syringes, ampoules, excipients and, above all, vaccines. In Portugal, compulsory patent rights licensing based on reasons of *public interest* is currently provided for in Article 108(1)(c) of the Patent Law. Article 111 of the same law specifies the conditions for granting these licences. One condition for their issue is a reasonable period of *prior negotiations* between the patent holder and the person interested in commercially exploiting the invention.

The current Industrial Property Code (2018), as previously mentioned, does not expressly enshrine the waiver of prior negotiations in cases of national emergency, in situations of *extreme urgency* or in cases of *public non-commercial use*. Furthermore, in Portugal, the compulsory licence is always issued *at the request* of the interested party. That is to say, there is no such thing as a compulsory licence issued by the Government or the competent minister (e.g., Ministry of Health) of its own motion.

On the other hand, the aforementioned Article 9(2) of Regulation (EC) No. 816/2006, of the European Parliament and of the Council, of 17 May 2006, on *compulsory licensing of patents relating to the manufacture of pharmaceutical products for export to countries with public health problems*, provides that *prior negotiations* are waived in national emergency situations or other circumstances of extreme urgency, or in the case of public use for non-commercial purposes.

There is greater justification for discussing the possibility of issuing compulsory licences before granting patent rights—which is already provided for in some (albeit very few) legal systems[6]—when we are faced with emergency situations (affecting public health), such as the situation affecting us since January 2020 with the SARS-CoV-2 pandemic. Requests could be made either *after* the patent application has been published or *before* its publication but *after* it has been filed. The overwhelming majority of legal systems do not provide for the issue of compulsory licences for products subject to a patent application, but only those subject to patent rights. Let us see.

Article 8(1) of the TRIPS agreement, for example, states, as one of its basic principles, that Contracting States, when formulating or amending their laws and regulations, may adopt measures necessary to protect *public health* and nutrition and to promote the public interest in sectors of vital importance for their socioeconomic and technological development, provided that those measures are compatible with the provisions of the Agreement. In view of the declared pandemic situation due to COVID-19, Germany was one of the first States to operate this possibility, with the *Gesetz aur Verhütung und Bekämpfung von Infektionskrankheiten beim Menschen – Infektionsschutzgesetz – IfSG*, at the end of March 2020 (Bundesministerium der Justiz 2000; Musmann 2020).

The same happened in France. Law No. 2020-290, of 23 March 2020, amended Art. 3131-15 of the *Code de la Santé Publique*. Henceforth, the

[6] The new Spanish Patent Law of 2017 (effective on April 1, 2017) expressly provides for this possibility in its Article 95(1), in accordance with which "For reasons of public interest, the Government may submit, at any time, *a patent application* or a patent granted, under the mandatory licensing regime, available as such by royal decree"—our translation and italics. In addition, Article 97(2) *a)* of this Law waives the requirement of a period of prior negotiation between the party interested in having the compulsory licence granted and the right holder "In cases of national emergency or in other circumstances of extreme urgency"—our translation.

French Prime Minister may, when a *state of health emergency* is declared and with the sole purpose of guaranteeing public health, determine the practice of the following acts: "order the requisition of any person and of all the goods and services necessary to combat the health catastrophe", and "take all measures to make available to patients adequate medicines for the eradication of the health catastrophe". Likewise, on 14 December 2020, Article L. 5121-12 of the *Code de la Santé Publique* was amended, in order to allow the use of medicines protected by patent rights or patent applications when these are subject to an *ex officio* licence in the interest of public health.

6 Alternatives to Patent Law

Current efforts to give effect to the rules provided for in Article 31*bis* of the TRIPS Agreement—on the possibility of issuing a compulsory licence for the manufacture and export of active substances (and other materials) used in the manufacture of medicines protected by patent rights—seem, for the time being, to be a futile and ineffective exercise to solve the problem of the scarcity of vaccines and other treatments used (or to be used) in the fight against the SARS-CoV-2 pandemic (especially in Africa and some Asian countries) and, in the future, the problem of other variants and other diseases that mobilise the use of biological materials (e.g., RNA).

It is true that the threat of this type of licences being issued by the competent administrative bodies has already been seen to contribute to the voluntary joint cooperation in technology transfer agreements that will enable certain companies to manufacture vaccines in countries heavily affected by this pandemic (e.g., India).

The flexibility provided for in the aforementioned Article 31*bis* of the TRIPS Agreement—which has already made it possible to waive the requirement that the issue of compulsory licences for patent rights and any related use shall be authorised predominantly for the supply of the domestic market of the Member authorising such use—will likely imply international pressure on some countries (in particular, India) to make better use of their installed industrial capacity. Yet, there appears to be little possibility of breaking the deadlock, given the European Union's opposition based on the claim that the safeguards currently existing in the TRIPS Agreement, regarding compulsory licensing of patent rights, read together with the *Doha Declaration* (2001), are fully sufficient. It is worth stressing that these provisions, in this approach, are sufficient to deal with the current COVID pandemic.

In other words, there is no lack of voluntary licensing agreements already signed to manufacture and distribute COVID-19 vaccines, the administration of which is destined for countries that have installed industrial capacity to manufacture these vaccines. However, vaccine shortages continue to exist in developing countries (in Africa), presumably because of financing difficulties (e.g. the need to make market commitments in advance, in terms of promissory purchase and sale, distribution or commercial concession agreements, etc.), poor planning (the Indian government, for example, started placing vaccine orders only in January 2021), and regulatory issues of civil law, pharmaceutical law, and tax law (e.g., liability waiver for damages caused in the administration of medicines; exemption from price controls; exemption from provisional testing and exemption from customs duties).

However, it should not be forgotten that there is considerable under-use of vaccine production capacity in these countries, since many manufacturing facilities do not have licences to operate and may only obtain these in the medium term. On the other hand, it is accepted without contention that vaccines already on the market cannot be reverse engineered; in other words, they cannot be manufactured without the active cooperation of the pharmaceutical company(ies) that developed the vaccine. This involves *technology transfer activities* (along with know-how agreements), which, in themselves, depend on the availability of highly qualified personnel and raw materials (e.g., adjuvants, excipients, intermediate products; biological materials). It is difficult to know the amount of know-how (and confidential information) that can be transferred or

communicated if compulsory licensing rules are implemented for the manufacture of vaccines (and other medicines) and their export to countries with serious public health problems in this area of SARS-CoV-2.

In view of the above, within the framework of the State task of pursuing the *public interest* — given the *public health emergency* situation that the SARS-CoV-2 pandemic raises, which will probably protract in time as the variants and mutations of this virus emerge and evolve — it seems legitimate to propose the following guidelines as viable alternatives to patent law:

- Compulsory licensing of patent rights (and supplementary protection certificates) relating to the use of patentable inventions for reasons of public interest in the medical and pharmaceutical field should have as its object the rights arising from the *patent application itself*, rather than just the patent rights in force in the territory of the State that granted them or where they were validated (this is the case of European patents granted by the European Patent Office).
- The requirement of *prior negotiations* between the Public Administration (or an interested person) and the patent holder (or the patent application holder) in national situations of emergency or other circumstances of extreme urgency, or in cases of public use, should be waived for non-commercial purposes. As a way of mitigating the circumstances in the legal sphere of the holder or applicant of the industrial property rights, the Government could publish, with reasonable notice, a list of chemical substances (e.g., active substances, excipients, adjuvants) or other materials for which it is justifiably considering issuing a compulsory licence, in order to be able to negotiate the possible issue of a *voluntary licence*; Universities, public laboratories, private teaching and research institutions and members of civil society could be consulted in the process of preparing that list.
- The Government (or the Ministry of Health) should be legally authorised to determine, by means of an Order, under Article 111 of the Portuguese Industrial Property Code, that an invention protected by a patent or a supplementary protection certificate concerning products, processes or uses mentioned in the previous paragraph may be used based on reasons of public interest, establishing the terms of such use and the equitable and adequate remuneration due to the patent applicant or patent holder.
- There should be an extension of the term of *exclusive marketing rights* (e.g., adding up to a maximum of 18 months to the terms in force in cases of medicines aimed at treating highly contagious diseases) and the possibility of transferring these exclusive rights from innovative companies (which have obtained these rights for medicines to treat diseases of populations in underdeveloped countries: e.g., AIDS/HIV, malaria, tuberculosis) to drugs companies whose patents are expiring (*vouchers*);
- Provisions should be made so that these *vouchers* can allow their purchasers to benefit from a shorter period of health approval for other medicines;
- Conditional and temporary *tax benefits* could be granted to pharmaceutical companies that develop and place on the market certain types of biotechnological medicines with considerable benefits or that develop new biotechnological medicines with significant therapeutic action;
- Pools could be created of patent rights transferred by pharmaceutical companies and held by non-profit entities whose members are those companies, and which thus have (cross) access to these technologies at a very low cost;
- -There could be a legal imposition of *standard contractual terms* (with a vertical effect throughout the research, development and marketing chain) aimed at enabling an easier and less costly use of chemical substances and biological (or biotechnological) raw materials with therapeutic properties in agreements signed between companies that have benefited (at least one of them) from state support/aid in research and development programmes (e.g.,

chemical or biotechnological synthesis, composition of active substances, methods of use of substances already disclosed), as well as, in some cases, (co)ownership of the patent right or the patent application right.
– It should be possible to waive patent rights already granted (or to be granted) on chemical and biotechnological inventions in exchange for granting patent rights holders a longer term of protection of test data as a result of the marketing authorisation of medicines given by the competent health authorities (For further developments, cf.Gervais 2019, p. 385).

These legislative changes could be made both in the Portuguese Industrial Property Code (Articles 108(3) and 111) and in Law No. 81/2009, of 21 August (public health surveillance system) (Marques 2020, p. 121).

7 Conclusions

The advent of epidemics and pandemics—especially the COVID-19 virus pandemic—calls for a reflection on the social utility of patent law (and supplementary protection certificates for medicinal products) in stimulating research and development of new therapies over the course of time. These incentives, which belong to the legal subsystem of industrial property rights, are articulated with and compete with incentives for the introduction of innovative biotechnological medicines coming from the legal framework on pharmaceutical regulation, with regard to the manufacture and placing on the market of medicines and medical devices (marketing authorisation procedures).

The threat of imposing compulsory patent rights licensing (limited, however, to the territory of the State whose Government issues them) serves as a deterrent and encourages the conclusion of know-how sharing agreements, as well as agreements aimed at voluntary licensing of patent rights and supplementary protection certificates.

In a more or less distant future, it may be possible to imagine a set of legislative measures aimed at stimulating the scientific and (bio)technological development of medicines outside the framework of patent law and supplementary protection certificates (with a patent extension term). This objective will depend on a global meeting of minds within the World Trade Organization, with a view to amending the TRIPS Agreement.

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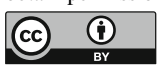

Fighting *Listeria monocytogenes* with Bacteriophages: Biotechnology for Food Safety

Maria João Estorninho and Paula Teixeira

Abstract

There are many nature-based antimicrobial solutions that could be used to decrease food spoilage and increase food safety. The use of bacteriophages (phages), viruses that infect bacteria but not human, animal or plant cells, is an example of a biotechnological approach for food preservation. Bacteriophage P100, marketed as LISTEX, was the first bacteriophage product to be Generally Recognized As Safe (GRAS) by the US FDA. This phage is active against the foodborne pathogen *Listeria monocytogenes*, responsible for a severe infection in the elderly, neonates and the immunocompromised. In this article, ECJ Case T-568/19, Micreos Food Safety BV vs European Commission, is analysed as a starting point for a discussion on whether a novel legal approach to the use of phages in the European Union is needed.

Keywords

Food safety · Food waste · Biological control · European law · Listex P100

1 Introduction

The World Health Organization (WHO) estimates that each year food contaminated with bacteria, parasites, toxins and allergens accounts for 600 million cases of illness and 420,000 deaths worldwide (Havelaar et al. 2015).

Improving food safety is essential if the United Nations Sustainable Development Goals are to be successfully achieved, particularly Goal 2 ("There is no food security without food safety"), Goal 3 ("Food safety has a direct impact on people's health and nutritional intake") and Goal 12 ("knowledge and solutions for better control of foodborne pathogens reduce the number of food recalls contributing to a reduction in food waste").[1]

While it is generally accepted that food has never been safer than it is today,[2] it is also recognised that consumers have never been so demanding and so concerned about their diet.[3] Yet consumer demands are hard to meet. While,

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[1] https://sdgs.un.org/goals.

[2] https://mobil.bfr.bund.de/cm/429/bfr2go_issue_2_2018_en_interview-bernhard-url.pdf; https://www.fooddrinkeurope.eu/whats-really-in-our-food/.

[3] https://www.efsa.europa.eu/en/press/news/190607.

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on the one hand, consumers expect nutritious, safe and convenient food with a long shelf life, on the other hand they favour less preserved food—low in sugar, low in salt, and with no synthetic chemical additives—with minimal processing. It is within this framework that nature-based antimicrobial solutions find their place.

There are many naturally occurring antimicrobials (of plant, animal or microbial origin) that could be used in food preservation systems. Nevertheless, only a few have been commercially exploited. The lack of knowledge about their antimicrobial mechanisms, efficacy and safety prevents their use from being approved by official bodies.

2 Microbial Biocontrol Agents

Biological control by microorganisms and/or their metabolites, i.e., the use of harmless microbes to inhibit or destroy microbial pathogens or spoilers, is one of the oldest ways of using biotechnology in food systems.

Fermentation, a process relying on the activity of microorganisms, mainly lactic acid bacteria or yeasts, has been used to preserve milk, meat, fruits, vegetables and cereals since ancient times.[4] Lactic acid bacteria produce different inhibitory compounds such as organic acids, hydrogen peroxide, diacetyl, carbon dioxide and bacteriocins, and this arsenal can inhibit undesirable microbes. As a result, it is possible to make perishable products available all year round instead of only seasonally, and to increase diversity in diets.

Bacteriocins are antimicrobial peptides and proteins produced by bacteria. These inhibitory proteins are commonly produced by lactic acid bacteria and have demonstrated great efficiency in the control of some pathogens, namely *Listeria monocytogenes* in different food products (Pinto et al. 2008; Borges and Teixeira 2016; Peng et al. 2017; Ramos et al. 2020). So far, nisin, a bacteriocin produced by *Lactococcus lactis,* is the only bacteriocin to be licensed as a biopreservative. It was first licensed for use as a food preservative in England in the 1950s and its use has subsequently been approved in many other countries. Nisin was granted international authorisation by the Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Expert Committee on Food Additives in 1969. Nisin was also added to the European food additive list, where it was assigned the number E234.[5]

Despite the great potential of bacteriocins (Borges and Teixeira 2016), their use also has recognised limitations, namely, a narrow spectrum of activity, loss of activity in particular food matrices, sensitivity to proteolytic enzymes, a high dosage requirement and uneven distribution in food products. To overcome these drawbacks, the use of bacteriocins in combination with other environmentally friendly treatments has been investigated with very promising results. High pressure processing and bacteriophages are examples of some of these treatments (Komora et al. 2021).

Bacteriophages (or phages)—literally meaning "bacteria eaters"—are viruses that only infect bacteria. The first descriptions of what might have been bacteriophages date back to the end of the eighteenth century, but it was only in 1917 that D'Herelle reported "an invisible, antagonistic microbe of the dysentery bacillus" (D'Hérelle 1917, 2007).[6] The first documented clinical use of phages is dated 1919 and was also conducted by D'Herelle, at the Hôpital des Enfants, to treat four children with bacterial dysentery. Since then, bacteriophages have been the subject of intense research with various purposes. Remarkably, in 1969, Max Delbrück, Alfred Hershey and Salvador Luria were awarded the Nobel Prize in Physiology and Medicine for their discoveries on

[4] https://www.fao.org/3/x0560e/x0560e00.htm#con.

[5] https://webgate.ec.europa.eu/foods_system/main/index.cfm?event=substance.view&identifier=72.

[6] Archived from the original on 2010-12-04. http://www.webcitation.org/5uicsPk41.

"the replication mechanism and the genetic structure of viruses" using bacteriophages as models.[7]

Despite the promising use of phages in the treatment of infections, research on phage therapy slowed down in the U.S. and Western Europe in the 1940s with the advent of antibiotics. However, research continued in Eastern European countries, especially in Poland and in the former Soviet Union, and phages are now being reconsidered as therapeutic options for infections caused by antibiotic resistant bacteria. According to the World Health Organization, "There is no time to wait. Unless the world acts urgently, antimicrobial resistance will have disastrous impact within a generation.".[8] Currently, phage therapies are commonly used for the treatment of infections in Georgia, Poland and Russia, and these treatments are sought by patients from all over the world as there are still many legal limitations to their use in jurisdictions outside the former Eastern Bloc countries (Kutter et al. 2020). The 'compassionate use' of phages has allowed their use in exceptional situations in patients across EU and US (Patey et al. 2018).

Although controversial, the use of phages has been approved in many jurisdictions for other purposes, namely for the control of foodborne pathogens, and phages are emerging as biocontrol agents in food production (Hudson et al. 2005; Ribeiro et al. 2016; Endersen and Coffey 2020; Vikram et al. 2021).

In 2006, the FDA approved ListShield™ (a cocktail of phages active against *L. monocytogenes*) as an additive for ready-to-eat foods.[9] Later in the same year, LISTEX™ (phage P100 active against *L. monocytogenes*) was the first US FDA 'GRAS' (Generally Recognized as Safe) approved phage product.[10] Since then, other bacteriophages active against *L. monocytogenes* and other important foodborne pathogens (e.g., *Salmonella* spp., *Escherichia coli*) have also been approved and are commercially available.[11]

Phages have the ideal characteristics to be used as biocontrol agents in food and in the food processing environment, as they:

- are the most abundant organisms on Earth and can be isolated from natural environments;
- are self-replicating agents;
- only infect bacteria;
- are highly specific, "magic bullets" that only destroy the target bacteria;
- are not known to produce adverse or toxic effects on eukaryotic cells;
- do not alter the sensory characteristics of foods;
- can be produced at industrial scale.

However, these characteristics do not dispense with the need for careful selection of phages with potential food applications. Among other characteristics, they cannot harbour genes encoding for virulence determinants or antimicrobial resistance.

Furthermore, no phages have been approved at European-wide level, although the use of phages is permitted in some countries under national law.

3 Phages Targeting *Listeria monocytogenes*

Listeria monocytogenes is one of the most feared foodborne pathogens and is the most frequent cause of death due to contaminated food in developed countries (EFSA and ECDC 2021). Despite worldwide efforts by research organisations and the food industry to reduce the incidence of listeriosis, this pathogen remains a serious threat to human health and the food supply.

[7] https://www.nobelprize.org/prizes/medicine/1969/press-release/.

[8] https://www.who.int/docs/default-source/documents/no-time-to-wait-securing-the-future-from-drug-resistant-infections-en.pdfsfvrsn=5b424d7_6.

[9] https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-172/subpart-H/section-172.785.

[10] GRN No. 218 Bacteriophage P100 preparation from *Listeria innocua* https://www.cfsanappsexternal.fda.gov/scripts/fdcc/?set=GRASNotices&id=218&sort=GRN_No&order=DESC&startrow=1&type=basic&search=218.

[11] http://www.intralytix.com/index.php?page=prod; https://phageguard.com.

In addition to causing suffering, functional disability and death, *L. monocytogenes* and listeriosis have a huge economic impact, severely affecting not only health systems but also the food industry. *Listeria* is a common cause of major food recalls—for example, it was the 2nd largest cause in the USA in 2019. As a result, tons of foods are wasted as recalled foods are normally destroyed, and food manufacturers suffer great losses due to damage to their brand reputation. Recalls also prompt further food waste due to a matter of consumer perception—"just in case, better to throw it away". In addition, land used, human labour, water, energy and other resources that went into producing that food are also wasted. Although recalled foods only account for a fraction of food waste, food recalls are very high profile and lead to huge amounts of waste so, to the extent that we can minimize them. . .absolutely we should be putting the effort in".[12]

The ubiquitous nature of *L. monocytogenes* and its ability to grow in harsh conditions—including refrigeration temperatures, high salt concentration and low pH values—makes it difficult for the food industry to control this pathogen. Some strains (particular molecular subtypes) may be repeatedly isolated over time in the same plant for several months/years—recognised as persistent strains. This represents a major challenge for the food sector as cross-contamination by the equipment and general food processing environment is one of the most important sources of food contamination (Ferreira et al. 2014). "This is an unavoidable risk that food producers have when they are making their products, because listeria is everywhere and can pop up at any time despite all the rigorous hygiene measures that they undertake."[13]

However, in the EU, as mentioned previously, we appear to have access to a powerful weapon to fight *L. monocytogenes*:

> Even at a senior official level, it is not understood why, since 2007, the Commission has not been able to form an opinion on the way in which the use of Listex P100 in the production of food can be approved in the EU. (. . .) *Listeria* bacteria as such are more dangerous than COVID-19: a much higher percentage of *Listeria* victims die, experience miscarriages or persistent complaints such as paralysis. Of course, the important difference is that a virus is an epidemic disease that occasionally pops up; *Listeria* bacteria are not transferable from person to person, but they are latently present. A faster procedure for Listex P100 creates hope that the more than 1000 recent *Listeria* victims, especially in Spain, Germany and the Netherlands, don't get any 'successors'.[14]

4 The (Lack of a) European Legal Regulation on Phages

From a European legal point of view, in the absence of specific regulation on phages, the question arises whether bacteriophages used on food must be classified as decontaminants, additives or processing aids.

This is relevant in order to determine whether phages fall within the scope of application of EU Regulation No 853/2004, of 29 April 2004,[15] on the hygiene of foodstuffs, and, therefore, if a European authorisation is needed for such products to be placed on the market. In fact, according to Article 3 of that Regulation, "Food business operators shall not use any substance other than potable water or (. . .) clean water, to remove surface contamination from products of animal origin, unless use of the substance has been approved by the Commission".

On the other hand, according to Article 3 of Regulation (EC) No 1333/2008, of 16 December 2008,[16] on food additives, these "are substances that are not normally consumed as food itself but are added to food intentionally for a technological purpose described in this Regulation, such as the

[12] https://foodprint.org/blog/the-oft-ignored-environmental-impact-of-food-recalls-food-waste/.

[13] https://www.labiotech.eu/trends-news/micreos-phages-listeria/.

[14] https://www.theparliamentmagazine.eu/news/article/the-use-of-bacteriophages-against-listeria-as-a-nondecontaminating-processing-aid.

[15] https://eur-lex.europa.eu/eli/reg/2004/853/2021-01-01.

[16] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008R1333.

preservation of food". In order to ensure harmonisation, the risk assessment and approval of food additives must be carried out in accordance with the procedure laid down in Regulation (EC) No 1331/2008 of the European Parliament and of the Council of 16 December 2008, establishing a common authorisation procedure for food additives, food enzymes and food flavourings,[17] which ends with the Commission deciding whether to include a certain substance in the list of substances admitted in the European Union (Szajkowska 2012; Estorninho 2013; Estorninho and Macieirinha 2014; Meulen and Wernaart 2020)

Unlike the case of decontaminants and additives, use of processing aids does not require European authorisation. In fact, according to Article 2 of Regulation (EC) No 1333/2008, of 16 December 2008,[18] on food additives, processing aids are excluded from its scope of application. The Regulation defines a 'processing aid' as any substance which:

(i)	is not consumed as a food by itself;
(ii)	is intentionally used in the processing of raw materials, foods or their ingredients, to fulfil a certain technological purpose during treatment or processing; and
(iii)	may result in the unintentional but technically unavoidable presence in the final product of residues of the substance or its derivatives provided they do not present any health risk and do not have any technological effect on the final product.

5 ECJ Case T-568/19, Micreos Food Safety BV vs European Commission

On 19 June 2015, Micreos Food Safety BV, established in Netherlands, lodged an application before the EU Commission, for approval of the use of Listex™ P100, a phage-based product that can be used against the contamination by *Listeria* of ready-to-eat food, as a decontaminant to reduce the presence of *L. monocytogenes* in animal-derived ready-to-eat food.

On July 2016, following the adoption by the European Food Safety Authority (EFSA) of a scientific opinion on Listex™ P100, the Commission adopted a draft regulation authorising the use of Listex™ P100 for the reduction of *L. monocytogenes* in animal-derived ready-to-eat food, under Article 3(2) of Regulation No 853/2004. The draft was the subject of public consultation in 2017, but it was never approved. In the SCoPAFF meeting of July 2018 the Commission and the Member States failed to reach agreement on the question of whether Listex™ P100 used on animal-derived ready-to-eat food must be classified as a decontaminant, an additive, or a processing aid. This question was once again discussed at the meeting of April 2019 of DG Health and Food Safety. Belgium raised the point that there could be a distortion of the internal market, if Member States were to classify the product Listex™ P100 differently. The Netherlands asked for clarification as to whether the product was a processing aid (national authorisation needed), a food additive or a decontaminant according to hygiene rules. Some Member States indicated that they could accept it as a food additive (Germany, France). Germany and Austria highlighted that the safety of this product remained unclear. Following discussions, the chair indicated a willingness to seek legal advice on whether an authorisation in accordance with Article 3(2) of Regulation (EC) No 853/2004 was applicable, although repeating that in his understanding this was the case.

Later, 2018, Micreos submitted that Listex™ P100 should be regarded not as a decontaminant but as a processing aid, which does not fall within the scope of application of Regulation No 853/2004.

On 17 June 2019, the Commission informed Micreos that it did not intend to pursue the evaluation of the request to approve Listex™ P100 on the basis of Article 3(2) of Regulation No 853/2004 and also, regarding the new request by the applicant for Listex™ P100 to be regarded as a processing aid outside the scope of Regulation

[17] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32008R1331.

[18] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008R1333.

No 853/2004, that "even if Listex™ P100 were to be classified as a processing aid, it would fall within the scope of Regulation No 853/2004, to the extent that it is used for decontaminating purposes".

Micreos brought an action pursuant to Article 263 TFEU seeking the annulment of the alleged decisions of the Commission of 17 June 2019 by which the Commission (i) would have rejected its original application for the approval of Listex™ P100 as a decontaminant in animal-derived ready-to-eat food, or re-examined that application ('the first alleged decision'); and (ii) would have rejected its alternative application to regard Listex™ P100 as a non-decontaminating processing aid ('the second alleged decision'); and, (iii) would have prohibited the placing on the European Union market of that product as a processing aid for that food ('the third alleged decision').

The Commission contended that the application was inadmissible because the alleged decision prohibiting the placing on the market of Listex™ P100, contested in the main application, did not exist. In essence, the Commission submitted that the contested acts were not decisions or acts that were open to challenge and annulment. According to the Commission, they were merely informative.

By order of 26 September 2019, (T-568/19 R), the President of the General Court dismissed the application for interim measures as inadmissible and the main action was also dismissed as inadmissible, on 18 December 2020.

An analysis of ECJ Case T-568/19, Micreos Food Safety BV vs European Commission, allows us to conclude that, at EU level, neither has an authorisation for the placing on the market of Listex™ P100 in accordance with Article 3(2) of Regulation No 853/2004 been granted, nor has a decision prohibiting its use been taken. Furthermore, the Commission also stated it had no intention to propose a specific regulation on phages.

6 Conclusion and Perspectives

Traditional food preservation methods rely heavily on thermal processes. In fact, high temperature kills microbes, ensuring food safety and shelf-life extension. Nevertheless, thermal processes also alter the nutritional and organoleptic properties of food products. Moreover, with the need to intensify food production due to the increase in the world population, sustainability and mitigation of environmental impacts are key issues to consider in food processing. Biotechnology is uniquely positioned to address such challenges and microbiological biocontrol approaches are promising safe, environmentally friendly and chemical-free alternatives to ensure food safety and prevent food spoilage, in addition to the benefits associated with their minimal effects on the nutritional and sensory properties of foods. Further research is still needed to overcome some of the limitations and maximise all the potential benefits of these sustainable approaches, thus providing authorities with the knowledge they require to take decisions.

The COVID crisis has shown not only the need for deeper and stronger European health policies, but also that in cases of urgency, *public health* reasons allow the European Commission to use mechanisms of urgent response (for instance, the urgent authorisation for COVID vaccines). As regards the use of bacteriophages to fight *Listeria*, it is time to put an end to hesitations, lack of transparency and bureaucracy. The precautionary principle advocates a cautious approach in cases of uncertainty Fisher et al. (2006), but in the case of phages, extensive research demonstrates that they are natural, safe and green alternative solutions. The principle of sustainability implies a novel legal approach to the use of phages in the European Union.

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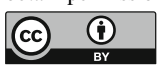

Genetic Engineering and the Law—Past, Present and Beyond: 20+1 Criteria to Help Focus the Path to Our Common Future

Margarida Silva

Abstract

Genetic engineering (GE) is a powerful molecular tool deployed daily in life sciences labs everywhere. When taken out into the world complex issues arise, many unanswered to this day. Three moments in time are considered in this analysis: the past, with the first generation of genetically modified (transgenic) crops, the present, focusing on the current generation of new breeding techniques, and the future, looking into what synthetic biology and cell manufacturing have promised. Twenty criteria that have shown promise in winnowing sustainability from failure, drawn from history, ecology and the law, are applied as tests to help understand whether society is moving towards the right outcome. An additional 21st criterion is suggested and an urgent call for change is issued.

Keywords

Genetic engineering · Sustainability criteria · Science vs. Society · Public policy · Solidarity

1 Introduction

In his compelling essay on (un)sustainability, the Laudato Si' Encyclical Letter, Pope Francis states one of the requisites quite clearly: "We require a new and universal solidarity." Could solidarity help science and society find the elusive path towards our common food future?

In the very broadest sense humankind has been genetically modifying plants and animals since before there was even a *Homo sapiens*. By choosing the juiciest fruit to eat, for instance, and unwittingly spreading the seeds, breeding had effectively begun. With the advent of agriculture and increased understanding of biological phenomena a more intentional approach developed over many generations, with crops and livestock carefully scrutinised to make sure carriers of the prized characteristics were chosen and multiplied.

The cumulative impacts of such efforts cannot be overstated: hundreds of thousands of varieties of humanity's most important food staples were crafted into our collective survival insurance. Corn is a case in point: the wild ancestor (teosinte) has many more branches, with dozens more ears. Teosinte ears are about 5 cm long, with just ten (very hard) grains or less, while corn ears grow up to 30 cm and can hold over 500 soft (hence easy to eat) grains. There are many other differences, and their common genealogy was at first all but obvious. Many hundreds of genes changed over time, but all these modifications

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and benefits were brought about within the confines of Nature's rules and limits.

The leading thread in the history of corn, and agricultural biodiversity, is that coevolution was allowed to happen over time—not out of some deep reverence for Nature but simply because no tools were available to do otherwise. It wasn't just the germplasm that evolved—plant seeds, animal breeds—but the cultural wealth accumulated as well: how to grow, how to use products for food, fuel, clothing fibres, shelter or medicine, and indeed how to keep all of it coevolving and meeting basic human needs alongside the rhythm of inevitable change.

Enter molecular biology after World War 2. For the first time ever genetic approaches allowed researchers to go into and directly rewrite life's inner sanctum: DNA. So a brand new technology, interfering with a newly reached dimension of our core infrastructure, came into being and rapidly developed to the point where it is now "do it yourself" for those with basic molecular training.

If society is to have a say in how technologies are run, namely regarding their environmental footprint, criteria must be established. In 2001, expanded later in 2013, the European Environment Agency (EEA) published the ultimate history lesson: what went wrong with technological debacles in previous decades and how they could have been prevented (European Environment Agency 2001; European Environment Agency 2013). In order to avoid repeating history the 12 late lessons the EEA uncovered would do well to be heeded today. These will form the first 12 criteria considered in this chapter.

Other rules must be obeyed, however, if health and the environment are to be protected. Not least among them are the principles embedded in Article 191 of the Treaty on the Functioning of the European Union (Precaution, Prevention, Polluter pays and Rectification at source). These are four additional criteria to be considered throughout the chapter.

It could be argued, however, that the decisive rule is Nature's. Whether modern society is to transform and survive or crash into oblivion like many civilizations prior comes down to how well we integrate into the web of life. Which rule is that? Perhaps Barry Commoner put it best when he enunciated his Four Laws of Ecology in the book "The Closing Circle": Everything is connected to everything else, Everything must go somewhere, Nature knows best, and There is no such thing as a free lunch (Commoner 1971). These constitute the final four criteria considered.

These 20 criteria are first detailed below then applied to genetic engineering's three main evolutionary stages (conventional transgenesis, new breeding techniques and synthetic biology) through relevant examples in order to evaluate overall (un)sustainability.

2 Twenty Sustainability Criteria

2.1 From the EEA's Late Lessons From Early Warnings

Respond to ignorance as well as uncertainty (LL1)—How can governments legislate and regulatory agencies set standards to deal with the unknowns of human activity? It's hard enough to make sure all relevant available knowledge is taken into account. And yet the need to avoid or at least approximately anticipate disruptions stemming from unexpected connections within the extremely complex, dynamic and seemingly chaotic system we live in is real and urgent. Ways to safeguard against unpleasant surprises are not failproof but ignoring these smacks of foolhardy arrogance.

Research and monitor for 'early warnings' (LL2)—Looking for the first signs that something is amiss means that research may start looking for trouble when no such trouble is detectable or even out there. However, waiting until it is obvious means protective action is delayed and wellbeing not maximized in instances where things do go wrong. It may take a long time before trouble becomes apparent to the naked eye and when it does that may still be insufficient for decisive action. At any rate the lack of early solid evidence aids and abets potentially destructive early inaction.

Search out and address 'blind spots' and gaps in scientific knowledge (LL3)—Being willing to look for weaknesses in current knowledge and act according to the gained insight is a sign of humility in the light of intrinsic human limitations and an essential condition when dealing with powerful new technologies, assuming health, the environment and the global future are to be secured. Political and business cycles, however, are seldom conducive to such reflection.

Identify and reduce interdisciplinary obstacles to learning (LL4)—Availability of knowledge does not guarantee the information will be put to use, particularly where fields of expertise must be bridged. A focused intention is required, which is not customary.

Ensure that real world conditions are fully accounted for (LL5)—The requirement that real life should be taken into consideration seems rather extraordinary in that it is obvious. And yet it became a late lesson precisely because of a widespread oblivion regarding the gap between theory and practice, between laboratory and field, between controlled conditions and the fallibility of the human condition.

Systematically scrutinise and justify the claimed 'pros' and 'cons' (LL6)—The decision to (dis)approve a particular technology requires the full evaluation of all its negative impacts, as well as its purported benefits. Evaluation must cast a wider net than usual and avoid the bias in prioritising some features over others.

Evaluate alternatives and promote robust, diverse and adaptable solutions (LL7)—Finding society's best path forward requires a full comparison within the options palette. Only when all opportunity costs are taken into account may the overall best choice become clear.

Use 'lay' and local knowledge as well as all relevant specialist expertise (LL8)—Nobody disputes the need to consider expert knowledge, but many forget it is not the only useful type of knowledge and could benefit from complementary sources, empirical or otherwise.

Take account of wider social interests and values (LL9)—Even if, hypothetically, a technological approach is (apparently) safe and stakeholders agree on its comparative effectiveness, it may still be widely unacceptable culturally, which should be reason enough for rejection.

Maintain regulatory independence from economic and political special interests (LL10)—Any manner of conflicts of interest will taint the most democratic decision-making process. It also corrupts science itself, to the point where independent scientists risk becoming extinct.

Identify and reduce institutional obstacles to learning and action (LL11)—In an ideal world the same evidence would result in the same technical understanding across countries or government agencies. The fact that it does not serves to prove institutions can develop their own inner resistance to acting as needed.

Avoid paralysis by analysis (LL12)—Institutional stalling is one particular type of political obstacle and results in appropriate action being delayed. It frequently stems from an unwillingness to confront whoever stands to lose from the intervention. It is always possible to know more, but this should not stand in the way of action.

2.2 From the Treaty on the Functioning of the European Union

Precautionary principle (EUP1)—This is one of the most overarching guiding principles in the European Union when it comes to protecting the environment and health, and it is certainly among those that private economic concerns most fight against. It is both surprisingly self-evident and deceptively simple to apply. It is directed at a precise moment of the scientific process pertaining to any technology evaluation or monitoring: when there is some evidence of harm (but not enough proof or understanding that allows for a regular science-backed decision) while at the same time a holistic perspective points towards potentially significant impacts as a consequence of inaction. This effectively states that societies should act to curtail activities and incur economic losses even if later (when science has come up with a fuller explanation) the issue turns out to be

a false positive—because these are not as problematic as false negatives.

Prevention principle (EUP2)—Whereas the precautionary principle deals with uncertain threats, the prevention principle focuses on activities where there is sufficient knowledge of the negative outcomes to calculate their probability and determines that they should be avoided rather than remedied.

Rectification at the source principle (EUP3)—Something of a corollary to the previous principle, this one establishes that prevention should happen where the problem originates rather than down the pipeline.

Polluter pays principle (EUP4)—If prevention was not or could not be applied then the perpetrator must be held liable for damages. This does not mean a polluted environment is necessarily returned to its previously pristine condition, but rather that crime should not pay.

2.3 From Barry Commoner's The Closing Circle

Everything is connected to everything else (BCLE1)—The respected American naturalist John Muir put it clearly when he wrote, "When we try to pick out anything by itself, we find it hitched to everything else in the Universe." Ecosystems work through interactions, an unfathomably large number of them, creating a web of interconnectedness through which cascades of consequences ripple arguably forever. Even if reactions are not endless, they are also never zero and can outnumber our expectations.

Everything must go somewhere (BCLE2)—It would be interesting if we could make trash or pollution disappear. Alas, when they are gone from sight they have just taken up another form elsewhere. Nature deals with this requirement by turning one population's waste into another population's food. Industrialised society, however, has yet to make the transition which means currently many unhealthy accumulations occur.

Nature knows best (BCLE3)—This thesis runs counter to dominant western worldviews by stating that it is really hard to improve on Nature. Commoner posits, "any major man-made change in a natural system is likely to be detrimental."

There is no such thing as a free lunch (BCLE4)—The extraction of natural resources and the usage of ecosystem services may seem free for the taking but there is always a hidden cost. This includes the loss of opportunity for future generations, the health impact for the population at large or a cumulative long-term impact, among many others.

3 The First Generation

The year 1973 marks the beginning of conventional genetic engineering with the creation of the first genetically modified organism (GMO), a bacterium that incorporated added DNA containing an antibiotic resistance gene. Recombinant DNA had been made possible by the discovery of a special group of enzymes a mere five years prior. These enzymes can cut DNA at specific locations, as defined by the linear sequence of the four nucleotides that make up the genome. There are hundreds of such restriction enzymes available that vary according to the sequence recognised.

According to the World Health Organization a GMO has been changed at the gene level through a method that Nature does not use (WHO 2014). The European Directive 2001/18/EC additionally excludes humans and establishes some exceptions as to methods. The result is typically the presence of one (or more) additional gene (s) coding for a specific protein that in turn results in some added functionality for the host plant, animal or microbe. Target genes can originate in a closely related species or be transferred across different kingdoms, since the genetic code is universal across life-forms.

China was the first country to allow introduction of a GMO onto commercial markets, with tobacco in 1992 (James and Krattiger 1996). In 1994 a genetically modified (GM) tomato was put

on sale in the United Sates. The European Union began approving GM products in 1994 with a GM tobacco strain, and GM food was first approved in 1996 (James 2001).

There are hundreds of genetically modified food varieties currently on the market in different countries, from species such as soy, corn, canola, rice, apple, papaya, eggplant, potato, sugar cane and sugar beet. Industry estimates that in 2019 about 190 million hectares were grown with GM crops, with soy and corn together representing 80% of the total (ISAAA 2019).

Some other species where GMO varieties have been approved include flowers, trees, beans and cotton. The United States remains the world's largest producer, with the top five countries (USA, Brazil, Argentina, Canada and India) growing over 90% of the world's GM area. In the European Union GM crops have been banned in a number of countries and from 2016 onwards only two countries have farmed GM products (with a single GM corn crop): Spain (30% of maize produced in 2019 was GM) and Portugal (6% was GM).

The technical procedure for GMO production is a sophisticated one. The gene of interest is isolated from the donor cells and cloned in the laboratory. It must be combined with support sequences that allow for adequate functioning in the target genome, including a selectable marker. The composite is inserted into the target cells which, for plants, normally involves shooting fine DNA coated particles into the cell culture or using a bacterial vector. Then cells are recovered by cultivation in a growth medium containing the selection agent, frequently antibiotics, and finally tissue culture techniques complete the regeneration process. At this point the GMO obtained are studied to determine which of them adequately expresses the desired trait.

The two traits that have dominated GM farming for 20 years and occupy over 99% of all hectares grown are herbicide tolerance (HT: where the transgene helps the plant survive herbicide applications that would otherwise kill it) and insect resistance (IR: where the transgene codes for a protein that kills insects that would otherwise eat the crop). These traits are frequently merged together into the same plant (stacked traits). SmartStax corn is one such stacked GMO: it carries two HT transgenes and six IR transgenes and is marketed for food and feed in the European Union, United States, Brazil and Canada, among others.

3.1 What Alternatives?

It is hard to imagine that humankind's food supply would ever be doomed had genetic engineering not been uncovered and developed. So what are the other options and how do they compare? There's organic farming, permaculture, agroecology, polyculture and small scale family farming—to name just a few concepts—besides the mainstream intensive farming option that uses conventional (non-GM) seeds. According to criterion LL7, any major decision should take all options and opportunity costs into account. However, this is notably absent from official GMO approval procedures on both sides of the Atlantic. The European Union (EU) has a stronger framework in place and does require pre-market authorisation. However the stated objective is narrowly focused on environmental and health risks. The approval procedure does not weigh strategic alternatives. If little or no problems are detected lawmakers give themselves no option but to approve. This is precisely the opposite of what criterion LL7 prescribes.

3.2 Alertness or Head Buried in the Sand?

With a technology that, for the first time in history, allows people to massively and irreversibly alter heredity directly at the DNA level, the need to be mindful of any unintended surprises might seem logical. And indeed there are some post-market monitoring requirements laid down in Directive 2001/18/EC but these are weak and incomplete. Two examples should be mentioned, among many more: in the case of HT crops no attention is given to the inevitably associated increase in herbicide use and, for stacked crops,

there is no requirement to assess the combined (and potentially synergistic) effects of the various herbicides and insecticides.

In the USA crops are often deregulated before hitting the market which translates into zero monitoring or oversight for their full commercial life cycle. Pre-market approval exemptions for most GMO are now available and allow companies to decide whether their GMO falls within the exempt or the regulated category.

Although different in scale, the European and American stances unveil the same underlying callous indifference to the need for immediate problem detection. Clearly no early remedial action can be expected from the highest echelons of these governments, which is exactly what criterion LL2 tells us is a bad idea, carrying poor prognoses.

3.3 What Voice for the People?

In 2010, the last year Eurobarometer surveyed Europeans regarding biotechnology, 67% of Europeans from 27 countries did not support GMO in food, 73% considered them unsafe and 78% saw them as unnatural. With 2021 hindsight, "the acceptance of GE by European people has not changed significantly over the past 20 years and remains at a relatively low level (Woźniak et al. 2021)." The "unnatural" epithet is not a scientific construct, nor does it have to be. It relays a feeling of unease towards what is seen as not fitting in with Nature. Notorious food scandals (mad cow disease being one among many) have likely shaped this position.

Public distrust notwithstanding, including an EU-wide petition for a ban on GM crops that collected over a million signatures and was the first submitted to the European Commission under the Citizens' Initiative provision (giving citizens a direct say in the bloc's legislative decisions), there are about 100 GM plant varieties approved for food consumption in the EU.

Labelling—meant to give sceptical Europeans the right to choose—is in place but its half-hearted reach means most GMO go where consumers do not see them (animal feed is labelled but it is not up to consumers to choose) and hence cannot avoid them (animal products are not labelled even when the animals were fed GMO for their entire life), among a number of other limitations.

American consumers, however, have it much worse. Even though 89% support mandatory package labelling (TMG 2015), there have never been federal requirements in place. In fact, even those companies that made sure their ingredients were GM-free were stopped from saying so. The federal government has recently published labelling requirements, due to go into force at the beginning of 2022, but these have been challenged in court because the information may not be visible (accessed through QR code only), the terminology has been changed ("bioengineered"), the symbol is nondescriptive and most GMO are excluded from the mandate, while States are banned from enforcing any additional requirements.

These examples illustrate the deep divide separating people from power. Had criterion LL9 been followed, reality would be better aligned with society's preferences and principles. The fact that it is not points to history repeating itself due to a failure to learn the appropriate lessons.

3.4 Who Pays?

What happens if GM seeds contaminate that which should be protected at all costs: heirloom seeds? These old, patent-free, adapted and adaptable open pollinated gems contain food germplasm diversity, the most precious of human survival tickets.

Examples abound of the difference a broad genetic base makes. Ireland's Great Famine in the 19th century resulted in the death of over a million people and originated in the genetically uniform potato stock that made the whole island (and beyond) susceptible to a fungal disease. On the other hand, in India and Indonesia, when a new virus ravaged rice production, agronomists spent years testing about 7000 different rice varieties looking for a gene that might help:

which they found, a single one in a single population from Uttar Pradesh (Brikell 2003).

The Portuguese laws (Decree-Laws 160/2005 and 387/2007) regulating coexistence—the set of rules governing the relationship between GMO and other crops because of GM contamination—offer a uniquely clear window into how genetic pollution is being handled in the brave new gene world. According to these rules contamination is not to be prevented, only minimised. And compensation is available only when commercial seeds are used. Seed saving and traditional varieties are specifically excluded from reparation.

In addition, by determining that only a small flat fee be paid by GM farmers these are effectively insured against any additional real costs. Overall either the polluter does not pay (where peasant seeds are concerned) or the payment covers just a very buffered amount of whatever might be due. At any rate, criterion EUP4 could not have been more profoundly ignored.

3.5 Science Speaks or Fake News Wars?

Over 80% of the GMO on the market are specifically engineered to withstand herbicide applications, which warrants a closer look at these chemicals. Even though various active principles (the main chemicals) are deployed, glyphosate held a virtual monopoly for over a decade and is still the dominant weedkiller option for HT GMO. Over time such agronomical choices rolled out two major unintended, interconnected and nefarious consequences that slowly became painfully clear: herbicide overuse and superweeds.

Although many promises were made about GM ushering in a new, cleaner agricultural era, between 1996 and 2011 US farming applied an additional 239,000 tons of glyphosate because crops were GM (Benbrook 2012). The reasons for this trend have not gone away.

As for the weeds targeted by glyphosate, faced with the immense selective pressure created by the widespread repeated use of a single control mechanism, it can be said that life happened. Resistance was first detected in 1996 and it grew slowly at first, then faster. In the US, according to the International Herbicide-resistant Weed Database at weedscience.org, resistance in GM soy fields, first detected in 2000, has now been detected in 7 separate weed species across 24 states. Ian Heap, one of the world's top weed experts, minces no words (Heap and Duke 2018):

> Although glyphosate-resistant weeds have been identified in orchards, vineyards, plantations, cereals, fallow and non-crop situations, it is the glyphosate-resistant weeds in glyphosate-resistant crop systems that dominate the area infested and [show] growing economic impact. Glyphosate-resistant weeds present the greatest threat to sustained weed control in major agronomic crops [...].

Rather than take objective science at face value the agrochemical industry has seized on the chance to turn the debacle into a business opportunity—and this is the reason why there are stacked GMO. Bayer recently announced in 2020 it has developed a new variety, tolerant to five herbicides at once. It is just a matter of time before weeds with the appropriate resistance genes conquer these new GMO fields. The impossible endgame, where we end up eating food modified by an ever larger number of transgenes dowsed with an ever increasing toxic cocktail somehow fails to be acknowledged.

The two examples above show that criteria EUP2 and EUP3 are far from being institutionally respected.

3.6 One Report, Two Reports, How Many Reports?

Few people and fewer administrations would question the legitimacy and the reports of the IPCC—International Panel on Climate Change of the United Nations as regards climate science. A similar type of body was created for agriculture: the IAASTD—International Assessment of Agricultural Knowledge, Science and Technology for Development ran for six years, starting in 2002, at the behest of the World Bank

together with other international agencies. The reports (Abate et al. 2009) produced involved around 400 experts, two rounds of peer review and many hundreds of stakeholders and were approved in 2008 by dozens of governments. This represented an inclusive, multidisciplinary, exhaustive and visionary attempt to model the best future for agriculture globally. Robert Watson, director of the IAASTD, famously said, "Business as usual is not an option." The documents emphasised agroecology, smallholder farming and agriculture's multifunctionality beyond mere food production, while criticizing GM crops in particular for being expensive with little benefit.

The IAASTD reports had little to no impact. Just some short months after their publication the FAO—Food and Agriculture Organization of the United Nations launched a debate forum with an almost identical focus. The World Bank itself had released another major document in 2007. Since then a number of multilateral initiatives with similar scopes have taken place and the rate shows no sign of abating. They all recognise the urgency of the situation and yet nothing happens.

Information being generated with no real action is a typical case of paralysis by analysis: precisely what criterion LL12 admonishes against. Another late lesson still unlearnt.

3.7 Who's to Judge?

No one wants a thief to sit as judge at his own trial. No one expects an oil company to be upfront about climate change. And no one should expect scientists to be independent when their work ties them in any way to the GM industry. Not surprisingly, when a GM researcher is financed by a GM concern results tend to be more favourable to the company's interests (Diels et al. 2011). This virtually means unless scientists are strictly independent their results cannot be trusted and should not be admissible. Yet industry studies on their own products form the basis of the European Union's GM safety evaluations.

How careful are European institutions regarding conflicts of interest? A 2017 review (CEO 2017) of the European Food Safety Authority (EFSA), the scientific focal point for GMO evaluations, showed that in the science panels 46% of the members had conflicts of interest. This is not a fluke; a similar analysis in 2013 had put that number at 59%. The situation has been so consistently dire that the European Ombudsman formally ruled that the EFSA should "revise its conflict of interest rules, and the related instructions and forms it uses for declarations of interests". The culture of undue influence by vested interests forced the European Parliament to send the EFSA several yearly demands on this subject between 2014 and 2020 (most of which were ignored by the agency).

If criterion LL10 had been taken seriously none of this would have happened. Since it did happen, this is yet another invitation for late lessons to surface in the future.

3.8 Real Life? What Real Life?

Substantial equivalence (in the United States) and comparative safety assessment (in the EU) are different phrases that embody the same concept—a politically charged, legally unacceptable and scientifically baseless decision to assume that ill-defined chemical similarity is synonymous with toxicological risk. The result is a safety testing waiver for most GMO. The incongruousness of such an approach is brought into sharp focus by mad cow disease. There is absolutely no chemically discernible compositional difference between a healthy and a sick animal, meaning they are 100% substantially equivalent. Nevertheless the risk clearly varies.

The adoption of substantial equivalence is a disingenuous way for GMO to be approved without any significant scientific oversight and the fact that some scientists acquiesce and participate in the farce can only be understood in the light of the previous lesson. It is also clear evidence that criterion LL5 currently has no bearing on GMO approvals in most of the world.

4 The Second Generation

As genetic engineering progressed, so the original transgenesis recipe—isolating a gene from a host, processing it and then inserting it into a target organism—evolved from 2001 onwards into a multitude of technological options. These new breeding techniques (NBT) ushered in the GMO 2.0 era, where direct genome edition of the target creates the desired variation.

According to the European Commission's Joint Research Centre there are currently four major approaches among the numerous genomic techniques available:

- Both DNA strands are cut then edited at the repair stage
- The genome is edited without breaking the DNA strands (or only one is cut)
- The DNA sequence is not altered but the way it is read into RNA is changed
- The RNA is targeted, rather than the DNA

The most widely used technique is by far the CRISPR-Cas9 method (from the first group above) which resulted in the 2020 Nobel Prize in Chemistry being awarded to the two researchers that discovered it. One of them co-authored a paper in a leading scientific journal anticipating a number of major well intentioned applications:

- Solutions for human diseases, such as those stemming from genetic disorders
- New antimicrobials, both against bacteria and viruses
- Improved crops and livestock, including improved yield in water- and nutrient-depleted environments
- Increased ease and versatility in the engineering of bacteria for industrial use
- Gene drives, that have the potential to eradicate malaria and other diseases

This brand new world of infinite genetic possibilities for biotechnologists has led Paul Knoepfler, from the faculty of the University of California Davis School of Medicine, to muse that it is akin to being a "kid in a candy store" (Plumer et al. 2018).

4.1 Precaution: It Would be a Good Idea

The European Academies' Science Advisory Council (EASAC), composed of representatives from 29 national academies of sciences in Europe, issued a statement on NBT (European Academies' Science Advisory Council 2015) that was supportive of the precautionary principle (PP)... apparently. Based on a United Kingdom House of Commons Science and Technology Committee report, the EASAC argued with its full institutional weight that the circumstances that justify a PP intervention, such as uncertainty, do not apply to NBT. This was stated even though it recognises that NBT "are emerging rapidly from advances in genomic research", which translates to: we are just beginning to grasp them, have yet to amass significant experience, do not fully understand the whole area yet and have no way of knowing if we ever will.

This conspicuous failure to recognise the internal inconsistencies points in equal measure to hubris and recklessness and does not bode well for the influence of scientists in decision making. At any rate this is but one among an unfortunately very large example pool of what can only be understood as a broader and recurrent pattern among life's technologists: an entrenched inability or unwillingness to self-reflect. At the very least it shows how criteria EUP1 and LL1 have yet to percolate through critical stakeholders.

4.2 Innovation: A Decision Was Made

Genetic engineering in general and NBT in particular represent a top-down approach to agricultural innovation. In the European Union research and innovation policies are guided by the Research and Technology Directorate of the European Commission (RTD), most visibly through its Framework Programmes that determine priorities and fund advanced knowledge institutions. This effectively defines who innovates, what is innovated upon and who benefits.

One of the targets and measures of success of RTD programmes is the generation of intellectual property (IP), but not all innovation is amenable to IP protection. Therefore those submitting grant proposals for products that can be "bottled and marketed" will stand a better chance of receiving EU funding (even more so when industry partners are brought into the team) and also, subsequently, large scale commercial success (because market outcomes depend on zeroing in on customers who can pay).

It follows that less wealthy niches and less protectable approaches (such as management strategies rather than products) are neglected or even undermined, which in fact creates a social bias that does not stem from sustainability potential, needs of the poor, efficacy, democratic choice or any other desirable criterion. Each path leads down to a very different food system (Quist et al. 2013).

The above can be summarised as a type of obstacle to learning, as defined in criterion LL11, reducing society's chances at a future.

4.3 Consultations: Knowing What You Want

In 2018 the European Court of Justice ruled that NBT fall within the scope of existing EU laws on GMO. This spelled bad news for the industry, as companies had been arguing that NBT do not create GMO, in order to avoid compliance with a law that says GMO should be safe and labelled. When Member States asked for a study on how to implement the ruling, the Health and Food Safety Directorate defined a methodology that included an invitation-only consultation of EU stakeholders. Of those chosen, 74% represented industry whereas only 14% were civil society organisations.

There is nothing wrong in asking vested interests what they think, but planning for misrepresentation that can skew the outcome ("capture") goes specifically against the Commission's own rules. Clearly not all contributions were equally welcome. This involves both non-professionals and experts from various fields and is an example where two criteria are breached: LL4 and LL8.

4.4 Connections: It's Who You Touch

Gene drives have raised particular attention since they bypass the Mendelian laws of inheritance and ensure genetic change takes hold of the entire population in a number of generations independently of (dis)advantages or external selection pressures. Thus the evolutionary arc of the population is altered and even planned extinctions could be possible. To expect that a modification of such magnitude will not create a tsunami-like wave throughout the web of life with any number of unforeseen consequences can only be seen as childish, goes against Commoner's BCLE1 and BCLE2 criteria and defies basic common sense.

5 The Third Generation

Genetic engineering's next frontier, as perceived by Todd Kuiken, a faculty member at North Carolina State University and previously with the Synthetic Biology Project at the Woodrow Wilson International Centre for Scholars, is undoubtedly synthetic biology.

Synthetic biology (synbio) was born at the crossroads of genetics, engineering and a Lego-like view of Nature. Taking advantage of powerful software tools, the life engineers (better still, synbioneers) aim at shaping DNA in their own image: the genetic code and a programmer's code become one, aligned with a specific technological worldview. Tom Knight, widely regarded as the original synbioneer, sees great advantage in the streamlining of biological systems into something "as predictable and free from complexity as possible" (Coghlan 2012).

In the synbio world upcoming food innovations include cell agriculture (e.g. meat from in vitro animal cell production), yeast farming (e.g. cow free milk, where milk proteins are produced individually then mixed in the right proportion), designer proteins for Mars outpost rations and many more.

Already on the market are mostly high value-added molecules aimed at the additives market for the food, feed, cosmetic, chemical and pharmaceutical industries. According to one expert, "There is potential for biosynthetic routes to completely replace any natural sources (Bomgardner 2012)." And for those that see engineered cells as still not robotic enough, the path is now open to sidestep them: cell-free protein synthesis uses dead cell extracts to better control the process.

Fully synthetic cells built from scratch (using inorganic components only) have not been created (yet) but cell mimics, which emulate some functionality of a natural cell, are already possible. "Regular" genetic engineering seems almost naïve by comparison.

One common thread is a self-professed respect for Nature as existential justification. Amyris Inc, one of the top public synthetic biology companies in the world, proudly states on its website:

> As the world's leading manufacturer of sustainable ingredients made with synthetic biology, our technology allows millions of people, young and old, to enjoy environmentally-friendly products that are made with our sustainable ingredients. Using sugarcane fermentation, we convert basic plant sugars into rare bioidentical molecules, essential ingredients and clean, effective everyday products. We are passionately pioneering the future of clean chemistry where people and planet can prosper.

Life has become the starting point for a new generation of chemical factories in the express name of environmental protection. What could go wrong? Nothing, at least for the time being, according to Tom Knight.

5.1 Six Reasons It Could Go Wrong

We might be forgiven for thinking that, since synthetic biology is, for now, mostly a contained endeavour, environmental concerns can be postponed. But, first of all, things leak. Human error made Chernobyl explode and could easily let synbios escape. Genes and microbes are not radiation but in a sense are worse, since life grows and multiplies.

The second reason is that once the tools have been developed, the knowledge has spread and public distrust has been won over, nothing but an act of God can stop a rogue biology major from unleashing society's worst nightmares.

Thirdly, these synbiobeings need fuel and that comes from the environment. Usually sugar cane is used as the source, but sugar cane plantations are notorious for human rights abuses, large scale monocultures, agrochemical dependency, excessive water consumption and profound biodiversity impacts. This footprint is not noted on Amyris's website.

The fourth reason: there is a subtle conceptual warping of human ethos when technologies become the go-to solution for human-made problems, as if the issues become less critical since we have powerful tools to figure out solutions. Why care for the planet when you can board a ship and leave for Mars? Of course, Mars is no planet B.

Fifthly, once technological applications become widespread and foster significant economic activity, they will not be easily stopped or changed, even when the negative impact is duly acknowledged. This has happened dozens of times in the last hundred years, according to the EEA report.

The sixth and last reason is that people's views of risk change. In 1975, at the Asilomar conference, scientists discussing what was then a frontier topic were concerned about the ramifications of genetic engineering and recommended containment be made a central tenet of any such endeavour. Alas, 20 years later, environmental release had become the norm. It is true that evaluations were carried out, technical opinions published and options legitimised. However, the underlying parallel evolution of what is generally acceptable cannot be denied.

The above six (non-systematic) issues regarding the currently non-existent environmental assessments for synthetic biology are good examples of how criteria LL3, LL6, BCLE3 and BCLE4 have not been adequately internalised, to the detriment of our common future.

6 In Conclusion: More Solidarity, Less Corruption

Genetic engineering failed the test on all 20 counts. The examples detailed above are but that: examples. Many more could be expounded, space permitting. Of course, instances of good Earth keeping can also be found, but a nuclear bomb on an organic garden still returns a nuclear explosion.

Deeper reasons underlying most of the cases mentioned possibly range from misguided commitment to outright corruption: political, economic and the egocentric type. The fact that corruption is so prevalent (Transparency International 2021) speaks volumes about its power—and science/technology are not immune. So far society has been unable to come up with sufficient countermeasures.

Lawmakers, at least those that would rather their grandchildren lived, would do well to mandate a systematic review of technologies of concern under the 20 criteria discussed here. But one more criterion is in order: that of solidarity. As Pope Francis notes in the Laudato Si' plea for integral ecology, solidarity is key. Without it we are condemned to heartless individualism and ultimate failure as a species. In fact, it can be argued that estrangement lies at the center of what separates us from our common future.

How these 20+1 ideas could become mandatory central pillars of environmental protection to help us home in on the path to a common sustainable future is not at all obvious. The fact remains that this is a matter of urgency, as sustainability is simultaneously non-negotiable and, right now, non-existent—at least as it pertains to genetic engineering.

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