POLICY BRIEF

MARINE GEOENGINEERING

A GREAT RISK FOR CHILE

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MARINE GEOENGINEERING: A GREAT RISK FOR CHILE

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ABSTRACT

This document presents the rationale behind why the State of Chile should regulate marine geoengineering, especially artificial iron fertilization in territorial waters (EEZ - exclusive economic zone). To this end, the case is reviewed of the geoengineering project based on experimentation with artificial iron fertilization promoted by the international company Oceaneos Environmental Solutions Inc. (from hereinafter Oceaneos). The scientific and legal frameworks of this type of project are also analyzed, with an emphasis on current limitations for decision-making. The recommendation that emerged from this analysis is that the State of Chile must proceed to ratify the amendment to the London Protocol in 2013. This amendment creates a binding regulatory framework that establishes the tools needed to assess and authorize this type of initiative, while ensuring that the risks associated thereto are analyzed independently and that the restrictions emanating from international instruments ratified by Chile, such as the Biodiversity Convention and the London Convention and Protocol, are safeguarded.

INTRODUCTION

The current climate crisis and limited success in reducing Greenhouse Gas Emissions (GHG) has led to an increase over the last decade in scientific, political, and public interest in the use of complementary technologies to fulfill the targets committed to in the Paris Agreement on Climate Change (2015). Geoengineering has been defined as “the deliberate large-scale intervention in Earth’s climate system” to counter man-made climate change (The Royal Society 2009, ix). Two very different types of technology have been regarded as Geoengineering: Solar Radiation Management (SRM) and Carbon Dioxide Removal (CDR) or Greenhouse Gas Removal (GGR) (The Royal Society 2009, ix). More recently, Negative Emissions Technologies (NETs) and Greenhouse Gas Removal (GGR) Technologies have been discussed (GESAMP 2019). Geoengineering is directly related to multiple aspects, including social, environmental, cultural, political, and ethical aspects, all

of which generate a high degree of complexity and uncertainty surrounding its impacts (Umweltbundesamt-German Environmental Agency 2019). Geoengineering is still in the planning, design, or small-scale experimental stage, and is not fully operational. This is primarily due to the uncertainty involving the direct effects anticipated and the magnitude of the intervention for it to be effective, as well as the impacts it could have on ecosystems and human life that have not yet been considered (The Royal Society 2009; Williamson et al. 2012). At the international level, governance of research in marine geoengineering has been regulated by the Convention on Biological Diversity and the London Convention and Protocol (GESAMP 2019). It is quite paradoxical that the aim is to reduce or delay major impacts through the use of these two geoengineering possibilities, but under no circumstances to prevent global warming. Rather, the focus is on helping to buy a little bit of time with these initiatives.

CDR combines a number of technologies to capture and remove CO_2 from the atmosphere and store it to prevent it from going back into the atmosphere quickly (Williamson et al. 2012; GESAMP, 2019). Artificial fertilization with nutrients is an example of CDR technology that is applicable to the ocean. Thus far, iron has been most commonly used because this element has been identified as deficient to limiting for primary production in various ocean areas and some coastal areas (GESAMP 2019). In theory, using iron aims to boost CO_2 capture via an increase in primary production and phytoplankton biomass as the result of the nutrients added to surface water (0-200 meters in depth) and the eventual sequestration of the carbon generated, in such a manner that it will be buried on the ocean floor or remain for extended periods of time in deep water (Williamson et al. 2012). The fertilization technique with nutrients through artificial addition to surface water is not complex, but it does require a constant addition process over large areas. However, existing scientific evidence based on small-scale experiments in primarily ocean areas has been controversial in terms of the ecological and biogeochemical impacts of artificial fertilizations, and in the majority of cases, carbon sequestration has not been successfully demonstrated (GESAMP 2019).

As such, this document reviews the case of artificial ocean iron fertilization for commercial and geoengineering purposes stemming from the risk of developing the initiative led by Oceaneos in Chile. In parallel, the scientific and legal frameworks of this type of project are reviewed to illustrate the current barriers for decision-making in Chile. On this basis, the

recommendation is to ratify the amendment to the London Protocol and thus put a scientific and regulatory framework in place for this type of initiative.

OCEAN IRON FERTILIZATION: OCEANEOS' PROJECT IN CHILE

In April 2017, the company Oceaneos publicly announced its intent to conduct an experiment in artificial iron fertilization that could increase phytoplankton biomass and primary production in the territorial waters of Chile (using the term "ocean seeding"). In so doing, this would also stimulate an increase in the Chilean jack mackerel (*Trauchurus murphyi*) and Peruvian anchoveta (*Engrualis ringens*) fisheries, as well as other fisheries primarily of artisanal interest, such as the swordfish (*Xiphias gladius*), yellowfin tuna (*Thunnus albacares*), the mahi-mahi or dolphinfish (*Coryphaena hippurus*), the cuttlefish, or the jumbo squid (*Dosidicus gigas*) (Oceaneos Environmental Solutions Inc 2017, 8). To date, this project is not publicly available, despite the fact that it received public funding through CORFO. Neither has it been officially submitted to relevant government agencies for legal permits, such as to the Directorate of the Maritime Territory, the Undersecretary of Fisheries, and the Hydrographic and Oceanographic Service.

In 2012, the same company, but under a different name, conducted a similar iron fertilization experiment to stimulate salmon fisheries in the Pacific Northwest along Canada (Tollefson 2012; GESAMP 2019). The results have not been published, but there is indirect evidence suggesting an isolated increase in phytoplankton and zooplankton biomass (Batten and Gower 2014). In the case of the increase in salmon biomass, a conclusion cannot be drawn based on scientific evidence that an increase was stimulated in fisheries, because it is possible the increase observed could be attributed to natural iron fertilization from volcanic eruptions (GESAMP 2019, 48). At the same time, company executives were prosecuted for not having applied for the corresponding national and international permits (Lukacs 2012). This, in turn, created intercultural conflicts due to having involved funds from the Haida indigenous nation through a corporation, the Haida Salmon Restoration Corporation (HSRC).

The project, whose aim was to obtain carbon credits (Tollefson 2012) and boost salmon fisheries, was declared illegal by Canadian authorities (Lukacs 2012). When it became evident that the project was illegal, it was rejected by the Haida Indigenous Nation in a

statement from October 18, 2012, which asserted that “the consequences of tampering with nature at this scale are not predictable and pose unacceptable risks to the marine environment. Our people along with the rest of humanity depend on the ocean and cannot leave the fate of the oceans to the whim of a few” (APTN National News 2012).

In this case, and with the proposals that followed, there was no record of scientific rationale for the experiment, nor experimental protocols, monitoring of the expected and derivative effects, risk assessment, or a review by scientists with experience in the issue (Williamson, P and Bodle, R 2016; GESAMP, 2019, 64). Similar experiments have been promoted by the company in waters along Ecuador, and more recently along Peru, all of which have had negative authorization results according to RES 357-2017-PRODUCE/DGPCHDI (Ministry of Production 2017).

Various professionals who were part of the HSRC experiments joined Oceaneos Environmental Solutions Inc. The former Director and Head of Operations of HSRC, Jason McNamee, who went on to become Chief Operations Officer of Oceaneos, claimed in 2016 that the Chilean project/experiment would not investigate its potential for carbon credits (ETC Group, Biofuelwatch, and Heinrich Böll Stiftung 2018, 82). Nevertheless, according to what was stated by Silvia Ribeiro (2018 emphasis on the original), “the current President of Oceaneos, Michael Riedijk, was responsible for “monetizing” the carbon credits to be generated by HSRC’s ocean fertilization activities, through his company Blue Carbon Solutions.”

Yet, not only did Oceaneos inherit HSRC's employees, but also their deceitful practices and unrealistic support. When presenting their experiment, the company Oceaneos indicated that it had the support of the National Confederation of Artisanal Fishermen of Chile (CONAPACH) (Oceaneos Environmental Solutions Inc. 2017, 1), and its president, Michael Riedijk, declared in a comment to the online newspaper *El Mostrador* (2017) that they had spread awareness on the project “at meetings with all of the relevant stakeholders in Chile.” However, the fishermen stated that they had never been formally asked for their support, and that they were not aware of any of the project details. Furthermore, the Commandeer and Head of the Department of Aquatic Environmental Conservation, Fighting Pollution, and Climate Change, Enrique Vargas, sat down for a formal interview with Samuel Leiva from Terram Foundation on September 4, 2018.

Through his testimony, the Chilean Navy refuted Riedijk's claims, and denied any knowledge of the project or having been in any contact with representatives from Oceaneos (Enrique Vargas 2018).

SCIENTIFIC ARGUMENTS AGAINST THE OCEANEOS PROJECT IN CHILE

In an analysis carried out by the scientific community in Chile with the support of international scientists who have been involved in reviewing this type of initiative, it was deduced that the artificial fertilization proposed by Oceaneos would use a much higher quantity of iron in one single place in comparison with small-scale scientific experiments that had been conducted to date by the international community. What is more, the place chosen by Oceaneos would be in territorial waters close to the coast (approximately 130 kilometers offshore). Meanwhile, the scientific experiments have been conducted largely in international waters (von Dassow et al. 2017).

The main ecological risks in executing Oceaneos' project in Chile are: i) the stimulation of harmful algal blooms, which in turn create risks for other marine species through trophic transfer, risks to human health, and socioeconomic conflicts related to fisheries and aquaculture; and ii) an increase in the intensity or magnitude of suboxic waters due to greater availability of organic matter in the water column, which could lead to mortality events of marine organisms, including those that constitute resources (von Dassow et al. 2017). There is also no scientific evidence as of yet that proves there would be a direct transfer of the resulting primary production towards higher trophic levels, given that the scales of time and space between this production (days - meters) and fishery production (months/years - greater scales) are very different, and there are various channels for transferring carbon in the ocean (von Dassow et al. 2017).

At its core, the Oceaneos project is a commercial experimental project that has no validated scientific basis for achieving the promised results. This is because it has a very simplistic vision regarding the ecological, biogeochemical, social, economic, and other effects that could arise from artificial ocean iron fertilization for solely commercial purposes. To that effect, a coordinated scientific working framework must be established for this type of project that would make it possible to anticipate and assess the potential impacts. This is especially important in light of the fact that, in the case of artificial

fertilization with nutrients, there are significant gaps in knowledge currently that do not make applying this technique viable, whether in terms of climate engineering or increasing fishery production (GESAMP 2019).

Various ocean science research institutes in Chile rejected Oceaneos' project via different media, thereby underscoring the uncertainties and environmental impacts associated with artificial iron fertilization on marine ecosystems and also on the national economy. In a letter sent to the press, scientists from IMO-Chile dubbed the project/experiment a "siren song." Although they recognize that this type of experiment contributes to understanding natural processes between the ocean and the climate, these projects do not make it possible to come to the conclusion that the increase of CO_2 is mitigated or that fisheries improve. In turn, they asserted that "the consensus is that artificial ocean fertilization (of this kind) must be prohibited for the time being" due to the great uncertainty in not being able to assess its real risks, and that the likely risks of the experiment in Chile could have the consequence of an increase in toxic microalgae (von Dassow et al. 2017). As a result, six marine research institutes provided ten reasons for rejecting the experiment (Millennium Institute of Oceanography et al. 2017), which can be summarized as follows:

1. The promised benefits are not supported by evidence validated by the international scientific community.
2. Science has formal channels of communication.
3. Science proposes experiments and validates its results through formal processes evaluated by peers.
4. There is no scientifically-proven methodology for assessing whether adding iron contributes to the production of fish.
5. The highly-unpredictable potential environmental risk of interventions of this kind in natural environments has not been considered.
6. Scientific experiments of this magnitude must not have commercial purposes.
7. Ocean interventions must comply with international agreements for protection of the marine environment.

8. The language used to describe this type of initiative must be transparent.

9. The example used to support this initiative is an experiment conducted in the Northern Pacific (2012), which was declared illegal and is currently undergoing legal proceedings.

10. There is no scientific evidence that establishes iron limitation as limiting to fishery production in the region of proposed experimentation.

LEGAL FRAMEWORK

At present, Chile does not have a legal framework in place that ensures or hinders the development of marine geoengineering experiments such as iron fertilization in national waters. As a result of this, securing a specific regulation is a necessary step for the country to be able to protect itself against the risks associated with activities such as these, which can affect productive systems and cause socioenvironmental impacts. However, Chile could indeed put a legal framework into place rather quickly by ratifying the amendment to the London Protocol that created an ad hoc regulatory framework. This would permit an ex-ante assessment of the impacts of iron fertilization based on international standards. The legal framework established by the London Protocol and the Biodiversity Convention is presented in this section, as well as the current legal situation in Chile.

INTERNATIONAL LEGAL FRAMEWORK

- London Convention and Protocol on the Dumping of Marine Wastes

According to what is described on the International Maritime Organization's website (IMO 2018), the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, or the London Convention, is an agreement for controlling marine pollution by dumping and for promoting supplementary agreements. It is governed by the IMO and covers the deliberate dumping of marine wastes or other matter from vessels, aircrafts, and platforms. The Convention prohibits the dumping of certain hazardous matter. It also requires a special permit prior to dumping a series of other identified matter, and a general permit prior to dumping other wastes and matter. This Convention has a Protocol that updated it, and which prohibits all dumping, except of matter found on the list of permitted matter.

The parties to the London Protocol adopted an amendment (Resolution LP.4(8)) in the IMO report on the current status of the treaty on October 18, 2013, to regulate the placement of matter for Ocean Fertilization and other marine geoengineering activities (International Marine Organization 2019). According to Article 43 of the Protocol, the amendment shall enter into force 60 days after two thirds (16) of the current 47 Contracting Parties to the London Protocol shall have deposited an instrument of acceptance of the amendment with the IMO. As of May 2019, the amendment has been accepted by five parties: the United Kingdom (2016), Norway (2016), Finland (2017), the Netherlands (2018), and Estonia (2019). Nevertheless, because it is party to the London Protocol, if Chile formally ratifies the amendment through National Congress, the regulations established in the amendment shall become part of the national legal framework.

- Amendment to the London Protocol

Resolution LP.4 (8), which amends the Protocol to include activities related to marine geoengineering, reforms Article 1 and adds a new Article 6bis and two new annexes (Protocol of the London Convention 2013, 3). In Article 1, it defines marine geoengineering as the "deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long lasting or severe." Thus, the experiment involving iron fertilization proposed by Oceaneos, for example, falls under this definition, and should be subject to the assessment created by this amendment. Additionally, in Article 6bis, the amendment stipulates that "the Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in annex 4, unless the listing provides that the activity or the subcategory of an activity may be authorized under a permit." Ocean fertilization is the only marine geoengineering technology that is currently identified in Annex 4.

In the second paragraph, Article 6bis states that:

> "The Contracting Parties shall adopt administrative or legislative measures to ensure that the issuance of permits and permit conditions comply with provisions of annex 5 and takes into account any Specific Assessment Framework developed for an activity and adopted by the Meeting of the Contracting Parties. A permit shall only be issued after the activity has undergone assessment which has determined

> that pollution of the marine environment from the proposed activity is, as far as practicable, prevented or reduced to a minimum. A permit shall only be issued if the outcome of the assessment is that the activity is not contrary to the aims of the Protocol" (Protocol of the London Convention 2013, 3).

Annex 4 of the amendment defines the marine geoengineering activities and for which cases permits should not be granted. For these purposes, Ocean Fertilization is defined as "any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans. Ocean fertilization does not include conventional aquaculture, or mariculture, or the creation of artificial reefs" (Protocol of the London Convention 2013, 3). In addition, Annex 4 stipulates that all ocean fertilization activities other than those referred to in paragraph 3 shall not be permitted. In turn, in paragraph 3 of Annex 4, it is established that no ocean fertilization activity should be considered for a permit without having been assessed as constituting legitimate scientific research given an assessment framework.

In Article 6bis, it concludes in Annex 5 with the creation of a new assessment framework for matter that may be considered for placement under Annex 4. If this assessment framework is ratified, it shall be mandatory. It complements the assessment framework adopted in 2010, which is a guide for the parties (International Marine Organization 2019a), and its main objective is for the parties to "determine, with utmost caution, whether a proposed ocean fertilization activity constitutes legitimate scientific research that is not contrary to the aims of the London Protocol" (Protocol of the London Convention 2013, 2). The current assessment framework only addresses ocean fertilization through the ratification of an amendment, which also considers geoengineering. Other marine geoengineering technological proposals will be addressed as they are introduced into Annex 4 of the amendment.

The 2010 Assessment Framework provides criteria for an initial assessment of a proposal and detailed steps to complete an environmental assessment, including risk management and the monitoring of ocean fertilization. As indicated on the International Maritime Organization's (IMO) webpage, the assessment framework does not contain a threshold below which experiments would be exempt from its assessment provisions. Regardless of its size or scale, each experiment must be assessed in accordance with the Assessment

Framework. However, it is acknowledged that the information requirements will vary depending on the nature of each experiment. It would be inconsistent with the Assessment Framework and resolution LC LP.2 (2010) for Parties to establish their own national thresholds to exempt some experiments from the Assessment Framework.

The elements of the Assessment Framework can be condensed into four larger sections: 1) initial assessment, 2) environmental assessment, 3) decision making, and 4) 2019 IMO monitoring. Therefore, an environmental assessment is conducted as part of this assessment framework, which includes problem formulation, site selection and description, exposure assessment, effects assessment, risk characterization, and risk management.

1. The **Initial Assessment** determines whether a proposed activity falls within the definition of ocean fertilization and has proper scientific attributes, and thus is eligible to be considered and evaluated in this framework. A report must be submitted to the Secretariat for the London Convention and Protocol upon completion of the initial assessment.

2. **Environmental assessment**: a series of analyses are carried out in this stage that focus on assessing and describing the possible environmental impacts;

1. Problem formulation: this describes the proposed activity and sets the bounds for the assessment carried out in subsequent steps;
2. Site selection and description: outlines the criteria used for site selection and data necessary for describing the physical, geological, chemical, and biological conditions at the proposed site;
3. Exposure assessment: describes the movement and fate of added/redistributed substances within the marine environment;
4. Effects assessment: assembles the information necessary to describe the response of the marine environment resulting from ocean fertilization activities, taking into account the short- and long-term effects. This section describes the factors to be considered for the evaluation of the impact hypothesis;
5. Risk characterization: integrates the exposure and effects information to provide an estimate of the likelihood for adverse impacts and the magnitude of those impacts. The risk characterization should include a description of the uncertainties associated with its conclusions; and

6. Risk management: structured process following risk characterization designed to minimize and manage risk and implement appropriate monitoring and intervention and remediation strategies to manage risks, including mitigation and contingency planning. Risk management procedures, based on a precautionary approach, are necessary to ensure minimization of environmental risks;

3. Decision making

The determination that a proposed activity is legitimate scientific research, and is not contrary to the aims of the London Convention and Protocol, should only be made upon completion of the entire Framework, including having satisfactorily completed consultation and appropriate communication and all conditions have been fulfilled. This should guarantee keeping disturbances and environmental damage to a minimum while maximizing scientific benefits.

4. Results of Monitoring

The collection and use of information resulting from monitoring informs future decision making and can improve future assessments. The details of the 2010 Assessment Framework can be found in Annex 6 of the report from the meeting of the parties of 2010.

- Biodiversity Convention

The Convention on Biological Diversity (CBD) from 1992 is an international legally-binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; fair and equitable sharing of the benefits arising from the use of genetic resources (Convention on Biological Diversity 2018). The discussion on geoengineering and its impacts on biodiversity have been broadly developed at five Conferences of the Parties from 2008 through 2016. After having studied over 10 technical documents since 2007, and having produced three technical reports, in its Decision IX/16 C (05/2008), the CBD decided through its Subsidiary Body on Scientific, Technical and Technological Advice to establish a de facto moratorium on ocean fertilization, and call for the work of the London Convention/Protocol to be taken into account (Convention on Biodiversity 2008, 7). However, the Decision establishes some exceptions for the development of ocean fertilization by allowing it to be done through small-scale experiments, in controlled

environments, with purely scientific objectives, carried out by academic institutions or research centers, and to be "submitted to a thorough prior assessment of the possible impacts on the environment" (Convention on Biodiversity 2012, 6). Nevertheless, ocean fertilization cannot be considered as constituting a small-scale experiment, due to the fact that the experiments must absolutely be carried out in the open ocean, which entails an unacceptable risk because "there is not enough of a basis to assess its potential risks" (Convention on Biodiversity 2008, 8).

The Convention on Biodiversity also points out that the impacts of this technique are great and unpredictable, and they could even go against the possible benefits indicated by its proponents.

> "If carried out on a climatically significant scale, changes may include an increased risk of harmful algal blooms, and increased benthic biomass. Potential effects on fisheries are uncertain. If Fe is used to stimulate primary production, increases in one region may be offset, to some degree, by decreases elsewhere. Ocean fertilization is expected to increase the midwater production of methane and nitrous oxide; if released to the atmosphere, these greenhouse gases would significantly reduce the effectiveness of the technique. Large-scale ocean fertilization would slow nearsurface ocean acidification but increase acidification (and potential anoxia) in mid- and deep-water. The small-scale experiments conducted to date indicate that this is a technique of doubtful effectiveness for geoengineering purposes. (Section 5.2.1) (Convention on Biodiversity 2012, 11, emphasis added).

On the other hand, the Biodiversity Convention is not the only convention or international body that has taken note of the need to avoid its use.

IPCC recognizes the moratorium and governance through the CDB and the LC/LP

The Intergovernmental Panel on Climate Change (IPCC) recognizes the authority of these conventions in the governance of the matter of ocean fertilization through its Special Report "SR 1.5 °C." It indicates therein that the London Protocol is the authority that regulates iron fertilization and the international governance framework is deposited in the

CBD through the recognition of this regulation as a “de factor moratorium of ocean fertilization commercial activities” (IPCC 2018, 346).

Other Entities:

In its annual resolutions on oceans and the law of the sea, the UN General Assembly continued to take note of the relevant decisions in accordance with the London Convention and the CDB, and it recapitulated that the States highlighted their concerns over the possible environmental impacts of the fertilization of the ocean in the document entitled “The future we want”.

Recent literature and reports suggest that one sole approach to the governance of geoengineering is neither desirable nor feasible. By contrast, national and international regulatory mechanisms must follow an approach that works depending on the specific characteristics of each technology and its risks.

NATIONAL LEGAL FRAMEWORK

Chile exercises jurisdiction and control over a maritime zone of up to 200 nautical miles (370 kilometers), including its waters, the continental shelf adjacent to its territory, its soil and sub-soil. However, there is no legal body at the national level in Chile that stipulates an environmental assessment of marine geoengineering or ocean iron fertilization in its Exclusive Economic Zone.

Environmental Framework Law

General Environmental Framework Law No. 19,300 is a relevant standard for the regulation of marine geoengineering (SEGPRES 1994). This law stipulates that only the projects and activities listed in Article 10 must be submitted to the environmental impact assessment system. However, it does not consider geoengineering projects nor experiments, even though they may not be commercial, due to the fact that they do not qualify as investment projects.

Regulation of the Environmental Impact Assessment System

Article 3 of the Regulation of the Environmental Impact Assessment System (MINAMB 2012) describes the details of the projects or activities that must be submitted to environmental assessment listed in Article 10 of Law No. 19,300. However, it does not identify ocean fertilization experiments nor projects.

General Law on Fisheries and Aquaculture

The General Law on Fisheries and Aquaculture is a law that regulates extractive fishing activities of hydrobiological resources, whether related to aquaculture or research. It also establishes the territorial or maritime framework in which it defines jurisdiction. Nevertheless, marine geoengineering experiments (ocean fertilization) are not an extractive activity, and are thus not under its jurisdiction.

Supreme Decree 711: Control of Marine Research

The only regulation in existence that pertains to scientific and technological research studies in Chilean waters is a Supreme Decree from 1975. Supreme Decree 711 embodies the approval of the Regulation on Control of Ocean Scientific and Technological Research Studies carried out in the Maritime Zone of National Jurisdiction (DEFENSA 1975). This decree stipulates a framework for recording any scientific initiative in territorial waters, which would include marine geoengineering research activities. The decree establishes that the Hydrographic Institute of the Navy exercises control over scientific research studies conducted by natural or legal persons, national or international, in the maritime zone up to 200 miles under national jurisdiction, including its waters, atmosphere, continental shelf, soil, and sub-soil. However, in Article 2, the requirements do not pertain to an environmental assessment nor an expected impact on marine ecosystems. The requirements are merely formal to identify the information of the proposer and the characteristics of the research, but they are not an assessment of environmental impacts (see the details from Articles No. 2 and No. 4 from Title 1 of S.D. 711 in the box):

Supreme Decree No. 711 - Title 1: Control of Ocean Scientific and/or Technological Research Studies conducted by foreign vessels or entities

“Article 2 - The request must at least contain the following information, without prejudice to other information that could be requested according to the circumstances:

1. First and last names, address, profession, and nationality of the requesting party.
2. If the request is made through a representative, the certificate or official document accrediting their representative role must be attached.
3. Indicate the sponsoring agency of the research study and the people that represent it in Chile.
4. Characteristics of the vessel, expressly indicating the elements it features to carry out scientific and/or technological research studies.
5. Attach inventory of the technical equipment that will be used in the research study.
6. Schedules, aims, and types of scientific research to be conducted.
7. Number of Chilean scientists that could participate according to the availability of the vessel, indicating the feasibility for them to conduct their own research studies.
8. Time the vessel will stay in the maritime zone of up to 200 miles under national jurisdiction, and schedules for docking in Chilean ports, thus indicating the national port from where they will embark upon their scientific activities.
9. Geographic region where they would like to conduct their activities and the sailing track.
10. Geographic position of the work stations.
11. First and last names, address, profession or specialty, and nationality of the participants in the research study.

[…]

Article 4 - The Hydrographic Institute of the Navy shall study the information on the case,

and must send the respective report to the Command-in-Chief of the Navy, thus indicating at the same time the number of Chilean researchers that should participate in the research study.
This Institute shall ensure that the actual participation of national experts is considered in the planning and execution of the program, and that the complete research results are made available to Chilean authorities. Likewise, it shall take appropriate action in the case so that, when possible, all or a significant part of the procedure and analysis of the data and samples obtained during the research are carried out in the place of the national territory it may determine.

Along with recording, the decree grants power to the corresponding institutions to designate participation of Chilean researchers and it determines that the complete research results are placed at the disposal of Chilean authorities. It stipulates that the Command-in-Chief of the Navy shall determine whether the request should be authorized, modified, or rejected; however, it does not define qualitative criteria for authorization.

The primary weakness of the standard of S.D. 711 is that because it is a supreme decree, it does not have the same legal superiority as a law, and, thus, could be susceptible to modifications depending on political willingness.

INTERNATIONAL CONTEXT

Ocean iron fertilization in and of itself is an activity with transnational characteristics because it could easily produce transboundary effects. Thus, consent must be sought out from all countries with jurisdiction and/or are located in the region of potential impact of any proposed activity, given this is the area of the ocean where it is expected for detectable changes to occur as a result of substances being introduced. This is why this issue has been addressed in various international agreements.

Situation in Chile regarding the amendment

Current comparative analysis: Regulatory Framework of the LP and S.D. 711

Requirements/Criteria	LP Regulation	Decree 711
Binding	X	✓
Submission of a research plan	✓	✓
Impact Assessment (does not include environmental)	✓	X
It applies to research projects	✓	✓
It applies to development/investment projects	✓ (moratorium)	X
It considers transnational effects	✓	X
It assesses the physical, geological, chemical, and biological conditions of the proposed site.	✓	X
It assesses exposure: the movement and allocation of the added/redistributed substances in the marine environment.	✓	X
It assesses the effects: the response of the marine environment, while taking into account the short- and long-term effects.	✓	X
It characterizes the risks based on exposure and effects.	✓	X
It incorporates risk management.	✓	X

In conclusion, S.D. 711 does not require an environmental impact assessment for geoengineering experiments or ocean iron fertilization, and national regulations stipulate that environmental impact assessments fall exclusively under the authority of the Environmental Assessment Service.

FINAL RECOMMENDATION

Due to the fact that Chile does not currently have laws in place that consider marine geoengineering projects or experiments, especially those involving ocean fertilization, it is essential for the Amendment to the London Protocol to be ratified, which creates a specific regulatory framework for this technology established in Resolution LP.4 (8) from 2013. This regulatory framework created by said amendment shall incorporate any other marine geoengineering technology that may be identified by the parties in the future. In addition to this, it will contribute to the establishment of the aspects of international governance necessary for confronting the transnational nature of the effects of marine geoengineering through the ex-ante consultation regarding any authorization with the Parties to the London Protocol. Lastly, this will make it possible to coordinate possible joint actions aiming to prevent impacts from the use of this technology on national and international marine ecosystems, while granting protection to marine resources of commercial interest.

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