The Ethics of Solar Geoengineering Research: Intergenerational Justice and Patterns of Vulnerability

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Word count: 7489 words

BSc Political Science: Specialization International Relations & Organizations
Bachelor Thesis

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What does the twin principle of participatory parity & recognition demand for future generations' rights when considering geoengineering research?

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Introduction

Earth as we know it is undergoing a greenhouse-induced global warming that has since the 1990s sparked many debates around the plausibility of geoengineering the climate (Jamieson, 1996, p. 323). Although not the first solution in the policy agenda to combat climate change, the insufficient and lackluster approach of humanity towards other means of adaptive or mitigative measures has led us to contemplate more radical options. Due to the increasing prevalence of geoengineering mechanisms such as carbon dioxide removal and solar radiation management in the recent decade, the epistemic community is now looking closer into the complex network of issues surrounding geoengineering rather than singling out the scientific and technical aspect of it (Preston, 2013, p. 23). Moreover, a functional geoengineering regime depends on a functional human system of deliberation and coordination, which emphasizes the importance of ethical scrutiny (Gardiner & McKinnon, 2020, p. 558).

Following the model elucidated by Preston (2013, p. 24), we can distinguish four distinct phases of geoengineering development where ethical issues may arise. Firstly, the contemplation of geoengineering itself questions the assumptions behind the ideation of such a technology. Secondly, research follows general guiding principles but also instills ethical norms that require scrutiny. Thirdly, implementing such a technology in society requires ethical considerations with regards to our global scale such as distributive justice. Finally, ethical issues that may arise post-implementation, most notably, the governance of geoengineering.

I consider that the first and second phase are intertwined because ideation and research can be thought as synonymous given that ideas constitute in itself a preliminary research of thought. Given that the large majority of discussions surrounding geoengineering has occurred in informal scientific meetings in the past, much of the development on the subject is still hidden from the general public and could be a ‘fait accompli’ before we get the chance to discuss in depth the ethics surrounding it (Jamieson, 1996, pp. 323-324). Furthermore, the geoengineering literature has dealt extensively on the issue of accountability and distributive justice but has failed to sufficiently assess the current power relations occurring within research and development, often weighing distributive justice as precluding the need to addressing procedural justice (Hourdequin, 2018, p. 283). If ethical evaluation is held at such high regard

for implementation and post-implementation concerns, why are we skipping the necessary steps that influence those same ethical concerns?

Jean Buck (2012, pp. 254-255) alludes to the narrative underpinning geoengineering as having the potential to mitigate suffering, including those most vulnerable to climate change. She also points out the looming possibility of disaster were it to fail hence affirming the importance of research and development as the root domain to scrutinize. Similarly, Jamieson (1996, p. 333) argues that research can only be justified if iterative ethical evaluations are part of the process seeing that research inherently develops entrenched interests influenced by the researchers involved. Additionally, McLaren (2018, as cited in Hourdequin, 2019, p. 468) doubles down on the remark acknowledging the empirical and normative assumptions permeating geoengineering research. As such, supplementing the aforementioned notion that ideation and research could be considered as a pair, I argue here more specifically that, research is the formalized version of ideation, of which process is subject to the standardization of norms.

For the scope of this article, I will be focusing on geoengineering through the lens of solar radiation management (SRM) rather than the plethora of technology as a whole. I will explain further the reasoning behind this conceptualization hereafter. Biermann and Möller (2019, as cited in Reynolds, 2020, p. 3) posits that current SRM debates are dominated by individuals from industrialized countries excluding voices from developing countries and especially the least developed countries which disregards major issues that are important to the global South. This paper will attempt to address the ethical issues surrounding SRM research with regards to the people most vulnerable to climate change, as well as their implications for intergenerational justice following the guiding research question:

What does the twin principle of participatory parity & recognition demand for future generations' rights when considering geoengineering research?

In the first section, I will conceptualize geoengineering and discuss the relevance of future generations' rights within SRM research. In the second section, I will elucidate Hourdequin's (2019) twin principle of participatory parity & recognition as well as its practice in today's institutional framework. In the third section, I will apply the twin principle to intergenerational vulnerability and urge the case for its inclusion in contemporary SRM research. To conclude, I argue for the need of representatives for future generations using communitarian ethics to suppose present relatives as the starting micro-level proxy within a polycentric solar

geoengineering governance structure. Additionally, I argue that the twin principle should be applied to future vulnerability through proxies on top of the current conceptualization which encompasses recognition and participatory engagement of the present most vulnerable. Finally, I warn that non-ethically comprehensive developments of SRM may keep the present vulnerable populations in patterns of vulnerability throughout generations to come.

Chapter 1: Geoengineering & future generations' rights

Conceptualization of geoengineering

The two most prevalent technologies when considering geoengineering in our contemporary epistemic community are carbon dioxide removal (CDR) and solar radiation management (SRM). Gardiner & McKinnon (2020, p. 557) explain that CDR addresses the causes of climate change by removing greenhouse gas from the atmosphere whereas SRM simply masks the effects of climate change rather than addressing its root causes. In addition, the speed of their impact post-deployment is also a significant differentiator (Gardiner & McKinnon, 2020, p. 557). Moreover, SRM acts faster and is more easily deployable than CDR which is why, SRM can be touted as a technology closer to fruition. However, the long-term approach of a safer CDR enhancing natural processes is still favored in comparison to SRM due to its associated risks and uncertainties (Preston, 2013, p. 24). With regards to modelling in research, SRM is highly speculative because it cannot be tested properly in laboratories or large-scale field trials which renders the model intrinsically uncertain (Adelman, 2017, p. 121). Robock (2008) enumerates a list of SRM effects that endanger our livelihood such as ozone depletion, the unknown interplay with plants, increased acid deposition, the formation of cirrus clouds and whitening of the sky. Consequently, given the preferential treatment that CDR discourse receives compared to the more problematic SRM processes, I will mainly be focusing on geoengineering as SRM throughout this article as I believe it warrants more attention.

Adaptation vs. Mitigation

When dealing with climate manipulation in general, some of the surmised effects that could incur from it would only be felt in later generations. In that light, contemporary research, if it were to be respectful of future generations' rights, would have to minimize those same risks as much as possible before concluding a workable implementation blueprint. Colloquially, measures associated to tackling the issue of climate change can be separated into two categories: adaptive and mitigative measures. Present mitigation aims to protect later generations from risks that might make them worst off than earlier generations (Rendall, 2011, p. 894). On the other hand, adaptation requires accepting the impacts of climate change in a given present time and finding solutions to cope (Caney, 2014, p. 330). For example,

infrastructure modifications to combat sea-levels rising, storm surges and increased flooding. The debate between adaptation and mitigation poses significant questions for intergenerational justice as well. Do we favor adaptive measures and focus on remedying the present? Or do we favor mitigative measures to ensure the survivability of near to distant future generations?

Intergenerational justice and the problem of discounting

For the purpose of this thesis and to disclose any apparent bias, I will be presupposing that both present and future generations have rights and interests that should be respected and accounted for. Rather, the responsibility of respecting these rights from an intergenerational standpoint, as much theoretically as practically, so that neither are disregarded, will be the focus of this section.

The question of intergenerational justice as an important facet of geoengineering has been mentioned multiple times in the current literature. However, the interplay between present and future generations to see which should be prioritized is still highly contested. Currently, intergenerational issues are often intertwined with the debate surrounding the discount rate. To summarize, zero pure time discounting puts present and future generations at the same weight of importance while positive pure time discounting, depending on if it is fixed or variable rates, adjusts the weight of future generations with decreasing importance the further they are in the future (Caney, 2014, p. 323). Arguments for zero pure time discounting revolve around moral equality, where temporality should not affect moral standing, as well as the 'best use argument' which states that pure time discounting offers suboptimal use and allocation of resources (Caney, 2014, p. 324). Nevertheless, some deem it too demanding for current generations to bear the brunt of the burden. Hence, many economists promote the idea of discounting benefits to future people which is consistent with the assumption that the same income to the rich (in the future) provides less utility than if the same amount were to go to the poor today (Rendall, 2011, p. 886). However, discounting presupposes that future generations will inextricably harbour much better capabilities than present people without accounting for variability in between (Nolt, 2017, p. 4). The rise of capabilities following a linear increase throughout generations, without falling at some point due to unforeseen risks and consequences, is to say the least, idealistic (Caney, 2014, p. 328). Nevertheless, economists back up this gap by hypothesizing that beyond a certain date, there may not be any future people to account for

anyways (Nolt, 2017, p. 4). Thus, favouring present subsistence over incremental sacrifice to potentially secure future subsistence.

To extend beyond the binary scope of applying zero or positive pure time discounting, Caney (2014) develops the concept of growth discounting. Such concept posits that some of the costs of mitigation can be passed on to future generations granted that economic growth is sustained into the future and that it is, practically speaking, possible to do so (Caney, 2014, pp. 337-338). Nonetheless, deferring costs and delaying action do not go hand in hand. According to IPCC reports, delaying action can be detrimental due to the uncertainty of adaptive capacities of future generations (Klein et al., 2014 as cited in Caney, 2014, p. 330). Additionally, it is also more costly to do so, which adds on to the reliance of continued economic growth into the future to be able to cope (Stern, 2007 as cited in Caney, 2014, p. 330). As such, growth discounting is highly context-dependent and does not give a clear-cut idea of how to defer costs effectively.

Although betting on future people to be richer is a gamble with good odds, like any gamble, it still bears risks that should not be glossed over (Rendall, 2011, p. 888). Nolt (2017, p. 5) references Rawlsian intergenerational political theory as ethically just guiding fundamental principles. Notably, the moral duty to avoid predictable harm to others as well as refusing to discount harm by justifying the accrual of harm into the future as a distinct issue from present ones. He adds that the idea of discounting future costs and benefits has been institutionalized by economists who had no prior incentive to take future people seriously to begin with (Nolt, 2017, p. 4). If anything, using this spatiotemporal separation to justify inaction holds similarities with our predecessors who burned fossil fuels before knowing its impact on exacerbating climate change (Nolt, 2017, p. 4). Confusing temporal separation with improbability and ignorance are not sufficient justifications to de-value or possibly endanger the welfare of future generations (Nolt, 2017, p. 5). Additionally, economic analyses are flawed because they assume utility maximization as an all-encompassing just principle, whereas the dynamics of intergenerational justice extend far beyond this narrow scope (Rendall, 2011, p. 885). Utilitarianism in itself is too demanding of a concept, incorrectly implying that future consumption counts for less while still supporting the sacrifice of the poor to the rich if the latter could gain enough (Rendall, 2011, p. 886).

Instead of placing the poor against the rich and vice-versa, Rendall (2011, p. 885) argues that the goal should be to minimize expected deprivation even at the expense of the global South if the global North is unwilling to support this logic. He doubles down on this argument by adding weighted prioritarianism to gauge better the distribution of benefits for which the worse off a person is, the greater the value accorded to said person (Rendall, 2011, p. 887). Comparably, sufficientarians seek to ensure a deeply satisfying life for people which transcends the threshold of merely accounting for survivability (Rendall, 2011, p. 887). Linked together, prioritarianism and sufficientarianism both aspire to reducing average deprivation which is measured in terms of extent and severity (Rendall, 2011, p. 888).

Overall, risk or cost-benefit analysis in geoengineering is inappropriate for future generations because it disregards non-substitutable loss and favours contemporary action over deferred benefits falling once again for the utilitarian fallacy (Adelman, 2017, p. 128). As such, to avoid accounting for unknown risks and hypothetical assumptions into the future that the epistemic community themselves have not been able to account for yet, I will be focusing the intergenerational arguments throughout this thesis on an egalitarian zero pure time preference, whilst favoring harm reduction and deprivation minimization.

Ethical considerations for future generations in SRM research

As I have explained previously, research is the formalized version of ideas and the most crucial preliminary phase in the standardization of norms. In this case, Adelman (2017, p. 120) calls for caution with regards to SRM because of its unforeseen consequences that could threaten the human rights of current and future generations alike, being especially risky for the climate sensitive regions of the global South who lack adaptive capabilities. As such, future generations being affected by the prospect of this technology, should be carefully considered in research as equally important as present generations. Although much of the debate around geoengineering has also emphasized the possibility to compensate for harm post-effect, I argue that issues of distributional justice and the question of accountability render this justification too loose. For the sake of space, I will not delve into redistributive arguments. Besides, situations such as non-substitutable loss and failure to enforce pay principles when assessing accountability pose too much of a threat to bet everything on a hopeful compensation scheme.

Moving forward, the importance of the research phase lies also on the influence exerted by the solar geoengineering epistemic community in framing issues and setting the policy agenda (Reynolds, 2020, p. 3). It follows that those representing the epistemic community, along with their inherent biases, hold much of the discursive power in deciding which issues are more prevalent than others. At face value, continuing research offers more knowledge to future generations, but others oppose this 'arming of the future' theory on the basis of moral corruption (Reynolds, 2020, p. 5). In particular, current SRM research could affect future decision-making to be unduly biased towards programmatic expansion due to lock-in mechanisms (Reynolds, 2020, p. 6). For that reason, the spectrum of representation is crucial in understanding the outcome of discussions within these forums. Therefore, given the risks associated, ethical considerations for future generations in SRM research matter and should be a primary subject of concern.

To sum up this chapter, I have elucidated the relevance of SRM geoengineering as an urgent topic of discussion. Moreover, I have linked it to questions of intergenerational justice, opposing positive pure time discounting to ultimately prioritize facets of intergenerational sufficientarianism, prioritarianism and egalitarian principles, in the hope of accounting for the risks and uncertainties associated with SRM. As an extension to that, I briefly note that ethical considerations for future generations in SRM research should not be glossed over.

Chapter 2: Twin principle of participatory parity & recognition within the institutional framework of SRM research

Conceptualizing the twin principle

Hourdequin (2019, p. 450) conceptualizes recognition as the respect for others distinct values or perspectives and their engagement in decisions that involve dialogue and interaction. She posits additionally that participatory parity represents formal and equal representation of diverse groups and individuals in decisions that affect them, which in itself is dependent on the prior fulfilment of criteria associated to recognition. Hourdequin (2019, p. 455) uses the example of Flint citizens' contaminated water and their disregarded concerns to exemplify the lack of recognition at the individual, structural, cultural and institutional level, in this case due to systemic racism. On the other hand, she uses the example of placing waste repositories in Nevada's Yucca Mountain to show the failure of recognition for differences, in this case overlooking the deep spiritual relationship to the land that the Shoshone and Paiute tribes had (Endres, 2009, as cited in Hourdequin, 2019, p. 456). Both exemplify instances of misplaced ethnocentricity which can blind us from our own parochial conceptions or expectations of how the world should work, and to combat it means to take into serious consideration the value of recognition (Hourdequin, 2019, p. 453). Thus, recognition serves as a formative component to building participatory parity given that it cannot be achieved without attention to recognition first (Hourdequin, 2019, p. 457). Throughout the remainder of this article, references to the twin principle will be alluding to this conceptualization of recognition and participatory parity by Hourdequin (2019).

The institutional framework surrounding SRM research practices

Customarily, risk evaluation has been reserved to scientists or economists in the field of geoengineering, but risk affects all, and should be considered a complex construct which requires a form of social and public discourse to influence ethical and political response in a manner conducive to representativeness (Adelman, 2017, p. 129). However, the current structure surrounding SRM research demands several points of scrutiny with regards to the actual representativeness within this institution. Firstly, the lack of common oversight

institutionally leads to the growing preponderance of individual interests which impedes the legitimacy of decision outcomes (Gardiner & McKinnon, 2020, p. 560). To add on to the individuality of interests, the centralization of research output being in western states excludes the voice of the marginalized and those especially vulnerable to global SRM (Hourdequin, 2019, p. 449), which in turn allows for facets of domination of the vulnerable states to appear indirectly (Gardiner & McKinnon, 2020, p. 560). Currently, some would argue that the institutional framework allows paternalism, enacting decisions in the assumed interest of the many without prior consent from those that will be most affected (Hourdequin, 2018, p. 276). Even if SRM were to ultimately be in the interest of the global poor, proceeding without their consent still constitutes unjust practices (Hourdequin, 2018, p. 277). Even worse, coupling a western-centric research force with the high risks of lock-in and path dependency that are associated to geoengineering research can only amount to non-representative and interest-biased outcomes (Preston, 2013, p. 28). If so, many ethical issues arise in the research phase of SRM development which begs the question: why have these issues not been addressed accordingly or put at the forefront of the policy agenda?

Jamieson (1996, p. 334) alludes to the lack of budgetary commitment to ethical background checks in geoengineering research, raising the related issues solely downstream in isolation of the scientific aspect of research, which seems to prevail exponentially over all other concerns. Scientific expertise especially in the case of SRM geoengineering takes precedence over other contributions to knowledge in the sphere of research (Hourdequin, 2019, pp. 460-461). Yet, this same prioritization of knowledge damages the attainability of participatory parity which is essential for a globally representative SRM policy agenda. Adelman (2017, p. 124) adds that the legitimacy of public consent can only be fulfilled if the technology developed is controlled and respectful of human rights of current and future generations. Nevertheless, in practice, to curb this dichotomy, SRM scientific discourse simply enumerates ethical concerns to clear the way for further research to reassure outsiders, while allowing expertise imperialism to guide the research given that it is devoid of relevant criticism (Hourdequin, 2018, p. 282). In order to attempt to shield the research process from such bias, principles that guide research conduct are of the utmost importance. Amongst the scientific community, the Oxford principles have had the most considerable impact in setting principles for geoengineering research (Reynolds, 2020, p. 4). I will come back to the implications of the Oxford principles later in the discussion when assessing the ethical conditionality of an appropriate SRM research scheme.

Parallel to discourse, the same bias of cherry-picking what should be included in scientific discussions can be found in modelling practices relating to SRM research. Researchers in this field are overconfident in their ability to predict and control SRM technology, falsifying their models to serve optimistic narratives by using counterfactuals and ignoring the level of variation with regards to vulnerability (McLaren, 2018, p. 215). Given that SRM modelling in theory should be used to assess climatic impacts, vulnerability is almost as important as the actual physical impact resulting from it. Still, limited criteria and assumptions are used in practice, omitting important dimensions of vulnerability along the way (McLaren, 2018, p. 216).

The twin principle in practice: working towards polycentric governance

Seemingly, the lack of oversight and respect for ethical evaluation has rendered researchers in the field to become complacent with regards to the importance of vulnerability. Adelman (2017, p. 133) hints at the disproportionate influence of a small geoclique of predominantly North American and British male scientists on the climate engineering agenda, stipulating that their 'can-do' attitude has pushed aside considerations for 'should we' questions. As such, given the narrow representativeness of the group and its lack of care towards questions of vulnerability, one could argue that Hourdequin's (2019) twin principle of recognition and participatory parity has not been fulfilled in this instance. Such practices, although evidently flawed, may continue due to the advent of expertise imperialism, in which the appeal to expertise in one field is used to justify control in another (Hourdequin, 2018, p. 280). In this case, vulnerability for North American or British male scientists may very well be conceptually divergent from a Latin American or Central African scientist for example, but the distinction is cast aside for practicality. Therefore, the choice of model, criteria, and weighting of factors, which are inherently biased by the researchers assigned to decide them, holds much of the discursive power (McLaren, 2018, p. 216).

In idealistic terms, such issues can be resolved with added attention to the twin principle. Although in practice, multiple barriers arise that may impede an efficient implementation of the twin principle institutionally. Jean Buck (2012, p. 266) emphasizes the challenge of scale for projects such as geoengineering which require participatory exchange to avoid the danger of implementation by the few, whilst being undertaken by the many. The dominant paradigm, if we follow the models that reflect it, assume artificial equality with regards to participatory

parity and procedural justice (McLaren, 2018, p. 217). However, real avenues to participate are often constrained by institutional and cultural misrecognition, which excludes the actual value of recognition as acknowledging differences within our common humanity (McLaren, 2018, p. 217). Nevertheless, stemming from the lack of representativeness for the current SRM research community, I argue that ethnocentricity and paternalism are inherent to their decisions regardless of the intent behind it. Hourdequin (2018, p. 279) states the risk of cultural parochialism arising from it, implying a limited view of the world, to which the added lack of reflexivity on one's own views is further damaging, but can be mended by inclusive dialogue. Yet, as stated previously, inclusive dialogue suffers from the challenge of scale. And although acknowledged in current discussions, the need for ramifications for an efficient governance of SRM research is still missing a criteria to determine when that will be implemented or when that will be relevant enough to address (Hourdequin, 2018, p. 281).

Surprisingly, states are relatively absent or rather shy away from solar geoengineering governance topics despite likely being the principal agents in future governance (Reynolds, 2020, p. 4). Aside from state-sponsored researchers, other agents are also contributing to the epistemic community surrounding SRM governance. Nongovernmental organizations such as the ETC group are active in deliberation and have voiced their hostility toward solar geoengineering (Reynolds, 2020, p. 4). Comparably, intergovernmental organizations such as the Intergovernmental Panel on Climate Change (IPCC) also participated in early efforts to establish solar geoengineering governance (Reynolds, 2020, p. 4). Despite the collective effort of various agents, little consensus has been established for a functional SRM governance model. Jean Buck (2012, p. 267) states the necessity to invent new forms of large-scale collective action due to local projects being limited by resources and multilateral projects collapsing under bureaucracy, corruption and a poor understanding of territorial dynamics (Jean Buck, 2012, p. 267). Another major caveat relates to pre-existing treaties such as ENMOD which SRM would inevitably violate were it to be implemented (Robock, 2008, p. 17). As such, one may wonder whether a new ethically comprehensive international treaty superseding its predecessors is needed to stray away from the current institutional standstill.

In 1998, the Aarhus Convention was the first multilateral environmental agreement to be signed which defined state obligations towards their citizens as well as encouraging participatory decision-making but was non-binding and ultimately lacked rigour overall (Adelman, 2017, pp. 136-137). As is the issue with many international treaties suffering from scale, binding

legislation is difficult to apply. However, according to Dryzek (2016, as cited in Reynolds, 2020, p. 3), institutions for geoengineering governance need to be global, paramount, and permanent. The global aspect as we have previously dealt with suffers from scale and would likely lack efficiency. On the other hand, a permanent treaty, unless it allows to be supplemented or superseded by future amended treaties, bears risks by possibly creating a barrier especially when SRM governance in itself is still intangible and complex policy-wise. Instead, I favor a segmented approach to governance in which micro decisions should translate representatively to macro decisions. Also known as polycentric governance, in which decision-making is spread out but coordinated across multiple sectors and scales, and key governance developments are warranted: a transparency mechanism, a global forum, as well as including solar geoengineering in the Paris Agreement's global stock take (Nicholson et al., 2018 as cited in Reynolds, 2020, p. 3). Likewise, Jean Buck (2012, p. 266) advocates for a decentralized and participatory governance of solar geoengineering but adds that states should have regulatory reports to address their commitments internationally. Humphreys (2011 as cited in Jean Buck, 2012, p. 266) distinction between commons-based and territorial geoengineering is helpful to understand the scope of SRM's potential effects. Solar geoengineering has global effects but inter-territorial variations. As such, the relevance of decentralized decision-making is to enable the observation of rural territorial dynamics, addressing it independently using multilateral funds before accessing the superior level of scale such as state-level deliberation (Jean Buck, 2012, p. 266). Unfortunately, although more representative in theory, the added complexity of polycentric or transnational governance brings about questions of accountability (Reynolds, 2020, p. 7). As a preliminary answer, I maintain that polycentric governance is still favorable in comparison to inter-state governance despite questions of accountability because the added representativeness matches the level of respect that the complexity of SRM demands.

To summarize this chapter, I built on the twin principle of recognition and participatory parity set out by Hourdequin (2019) to understand the current SRM institutional framework which enables bias and misrecognition with skewed deliberative outcomes. Additionally, I delved into the issues of knowledge hierarchy with ethics being cast aside in deliberation but also in modelling practices. Finally, I develop a case for polycentric governance advocating for increased attention to territorial dynamics. Overall, the present institutional framework surrounding SRM research does not favor the respect of the twin principle. In the following chapter, I will discuss what that entails for intergenerational vulnerability.

Chapter 3: Twin principle of participatory parity & recognition in SRM research applied to intergenerational vulnerability

The prospect of SRM for the most vulnerable

A Woodrow Wilson Center report characterizes vulnerability as the edge of subsistence, with the least adaptable to climate impacts and those voiceless in international discussions as the most vulnerable to geoengineering's side effects or consequences (Preston, 2013, p. 28). On a similar note, Adelman (2017, p. 122) specifies that the poor and vulnerable from the global South suffer the most because of underdevelopment, low adaptive capabilities, and a reliance on climate sensitive sectors. Conversely, McLaren (2018, p. 216) states that the level of vulnerability depends on capabilities and recognition but also the strength of social capital. For the ensuing discussion, an aggregate of these variables will be used to conceptualize a well-rounded understanding of vulnerability. From the discussion in the previous chapter, given the bias and misrecognition permeating SRM research alongside the disregard for ethics, the prospect of SRM for the most vulnerable must be assessed with caution.

Advocates of geoengineering previously surmised it as just adaptation for the most vulnerable people in the world (Horton & Keith, 2016, as cited in Gardiner & McKinnon, 2020, p. 558). Although true for some instances of CDR, SRM on the other hand, according to the solar radiation management governance initiative (SRMGI) report, transfers environmental risks to the poorest countries and the most vulnerable people (Preston, 2013, p. 28). The dichotomy between using vulnerability as an argument to proceed with SRM research without accounting for vulnerability in practice, does not match the recognition or respect that the most vulnerable should be treated with (Hourdequin, 2019, p. 449). Equally, SRM being only a mechanism to mask the threat of climate change for future generations rather than addressing it structurally or institutionally, fails to account for principles of intergenerational justice (McLaren, 2018, pp. 217-218). As such, knowing that the prospect of SRM for the most vulnerable today is in fact skewed and serves alternative narratives, I will delve further into the implications of SRM for my account of intergenerational vulnerability.

Dangers of SRM for intergenerational vulnerability

Before explaining the concept of intergenerational vulnerability and its relevance in the discussion, I will assess the dangers of SRM for near to distant future generations. The novelty of SRM could exacerbate pre-existing injustices hence requiring participatory engagement as a countermeasure, or colloquially in this paper, aiming to fulfill the twin principle in practice (Hourdequin, 2019, p. 464). Moreover, Robock (2008) lists a plethora of possible injustice scenarios for future generations. Namely, the effects of SRM on regional climates and precipitation patterns, the environmental impact and resources needed for implementation, termination issues, human error and unexpected consequences, the undermining of mitigation efforts, and finally, the potential marketization or militarization of the technology to serve domination agendas. All of these scenarios pose in some way or another a distinct danger for future generations' subsistence. But the most concerning one relates to termination issues given that the potential of irreversibility disregards future generations' choices, yet also leaves the practical feasibility of adjusting to termination issues to chance seeing that it is not possible to pre-determine a successful transition model from active SRM to null in the future (Jamieson, 1996, p. 330). By moving forward on decisions relating to SRM today, without considering implications for future generations, also assumes their implicit consent without anyone to rationally argue against it because precedence for representing future rights, or more specifically most vulnerable future rights, are defective institutionally. In simpler terms, SRM discourse processes lack protection, consent, representation, and benefits for the vulnerable (Jamieson, 1996, p. 329). The ensemble of these remarks point to a serious lack of moral accountability by those advancing hope for the advent of SRM for both present and future vulnerable people.

By linking both generations together, the argument for intergenerational vulnerability is as follows. If SRM exacerbates pre-existing injustices for the vulnerable into the future, yet the remedy of fulfilling the twin principle is not respected currently within institutions or morally, then the only solution is to wait on innovation with regards to the institutional framework to comply with the idealized version of SRM governance (polycentricity) or rely on other agents that traditionally have less of an impact than state-derived agents. However, due to the lack of representativeness and reflexivity for the most vulnerable in the epistemic SRM community today, optimism to rely on fundamental change could be misleading or arrive too late to make

a meaningful difference. As such, I argue that the vulnerable of today, if they continue to be subject of misrecognition and voicelessness, will lead to higher chances of sustaining patterns of vulnerability throughout generations.

Another overarching argument relating to the risks of SRM is the domination argument, whereas climate manipulation increases the risk of conflict because countries could end up manipulating the 'global thermostat' to their liking, symbolic of a hostile act (Adelman, 2017, p. 125). The potential of domination brings about new inequities by exercising climate engineering through the lens of a tri-dimensional aspect of intentionality: inequities can be generated intentionally to demonstrate power, unintentionally but with awareness or unintentionally without foreknowledge, all three are likely if SRM discourse moves forward (Hourdequin, 2019, p. 468). Still, Smith (2016 as cited in Gardiner & McKinnon, 2020, p. 559) adds that even indoor SRM research can affect power relations between countries, and that transparency does not suffice to avoid domination, but rather that the developed world should facilitate capacity-building and empower those most vulnerable to instances of domination. By bringing in the topic of vulnerability here, I argue that developed countries could very well emphasize that dedicating resources to capacity-building for others constitutes in itself a vulnerable allocation of resources. Given the ever-growing disparities between the rich and the poor, as well as the given context of contemporary SRM deliberation, I maintain with relative certainty that capacity-building is highly dependent on a new treaty providing legally binding protection for those engaging in altruistic capacity-building. Without it, neighboring vulnerable countries would likely suffer the brunt of developed countries battling it out to secure domination perks, hence adding to their vulnerability and potentially igniting patterns of vulnerability to be sustained. Despite this pessimistic account of inter-state relations, avoiding subjugation of the most vulnerable is still compelling from an ethical standpoint and should not be disregarded because of its potential hurdles (Adelman, 2017, pp. 130-131).

Applying the twin principle to intergenerational vulnerability

In the previous section, I stated that moving forward with SRM with the current institutional framework along with its customary practices, implies implicit consent from future generations due to their voicelessness in the decision-making process. In addition, technocratic decision-making or national and regional voting is insufficient to justify the risks and costs of implicit

consent, obtaining the widest possible level of consent prior is still of the utmost importance (Adelman, 2017, p. 134). Moreover, legitimacy is at the core of a functional geoengineering regime which itself depends on ethical accountability, hence, public participation should be facilitated and devoid of coercive manipulation (Adelman, 2017, pp. 135-136). But given the non-existence of future generations in present time, what could be the closest proxy to satisfy the twin principle of recognition and participatory parity for them in today's context?

Building on the prior incentive to work towards a polycentric SRM governance model and taking into account the lack of respect for the twin principle when considering present vulnerable people, I argue that strengthening present efforts to consolidate the twin principle in practice acts as an indirect starting point to respect future generations' vulnerability as well. Similarly, communitarian ethics require reciprocity between citizen and community which is naturally intergenerational due to the longevity of communities (Nolt, 2017, p. 6). As such, duties to the community become in part duties to the future which are enforceable by the community at present (Nolt, 2017, p. 6).

To curb the spatiotemporal separation of intergenerational vulnerability, I advance the argument that: on the basis of communitarian ethics, at the most basic micro level of a supposed polycentric SRM governance scheme, I would argue that a community predecessor is the most ethically representative for a proxy respect of the twin principle with regards to future generations' rights. As such, although non-existent in physical terms, an attempt to account for future generations' rights pre-emptively by respecting a proxy version of the twin principle through a predecessor, holds more discursive value over time than no attempt whatsoever. Moreover, given that polycentric governance also requires an increased attention to territorial dynamics, this argument is in line with the idea that: community-based geoengineering projects, contrary to the global scale assumption, can strengthen local institutions and address resource conflicts and insecurities (Jean Buck, 2012, p. 267). In this case, the surmised large-scale of SRM does not imply solely top-down management but invites local input, largely avoiding the common donor-centric approach to development (Jean Buck, 2012, p. 267).

Evidently, the assumption here is that communitarian ethics stand as the best option for the initial micro-level of a polycentric SRM governance structure. Moving upwards, regional, national or non-state actors can be additional representatives, acting as vocal aggregates of interests preceding them. Nevertheless, although highly dependent on a willingness to move towards polycentricity and to amend the current institutional discrepancies surrounding SRM

research, I advance this argument by opposition to simply accepting the implicit consent of future generations, which I have denoted as morally unjust with regards to intergenerational justice. In addition, Preston (2013, p. 29) questions the value of consent stating that a big part of the global population is unaware of problems surrounding climate change in general. As such, opening avenues of intergenerational proxy representation not only calls for more inclusive awareness to future generations' rights but also aids awareness for pressing climatic issues.

Conditions for a permissible SRM research

For this final section, I will briefly discuss conditions that render SRM research permissible on the grounds of sufficient respect for the twin principle of recognition and participatory parity as well as respect for future generations' rights.

As a starting point to the discussion, Jamieson (1996, p. 326) has previously delineated conditions for a morally permissible geoengineering project which includes technical feasibility, predictable consequences, added socio-economic benefits to states and respect of ethical principles or considerations. Taking into account the discussion up until this point, I would argue that current SRM research fails the predictable consequence aspect as well as failing to respect certain ethical principles, notably vulnerable people, and future generations' rights. However, failing to account for these general conditions can be damaging to the overall salience of the research. Preston (2013, p. 29) notes that including marginalized voices may not just be good ethics but also good science, by improving the promise of a large social impact within a framework of high uncertainty. Further down the line, the so-called Oxford Principles were one of the earliest attempts to set out principles of conduct for geoengineering and was submitted to the UK House of Commons in December 2009 (Preston, 2013, p. 27). Firstly, it specified geoengineering as a regulated public good. Secondly, asserting the need for public participating in geoengineering decision-making. Thirdly, an open-source publication of results for full disclosure. Fourthly, a thorough assessment of impacts. Finally, a workable governance regime before contemplating deployment.

At the time, the stratospheric particle injection for climate engineering team (S.P.I.C.E) advocated for a cancellation of SRM due to the lack of governance structures (Preston, 2013, p. 27). Similarly, I would extrapolate that idea to the prior level of research. I argue for a

workable governance regime related to oversight before legitimizing the continuation of SRM research. Due to the current inefficiency of the SRM epistemic community who employ traditional top-down management, the plausibility of polycentric governance coupled with proxy representation for future generations' rights still stands. As a preliminary thought towards idealized conditions for SRM research permissibility, I advocate on top of the Oxford Principles, for the inclusion and respect of the twin principle on an intergenerational level, serving as guiding fundamental principles for an ethically comprehensive research output. Meanwhile, the overarching pre-condition being a functional governance regime that enables these factors to take place systematically. If the SRM research does not fulfill those conditions, epistemic knowledge should not be translated into technological developments. Additionally, safeguards should be implemented within research itself rather than only including it at the development phase (Jamieson, 1996, p. 333).

To give a synopsis of this chapter, I began by justifying why geoengineering does not serve the interests of the present vulnerable people due to a lack of respect for the twin principle of recognition and participatory parity. I followed that assessment with an account of the dangers SRM poses for future generations, especially the factor of irreversibility implying implicit intergenerational consent by future generations. Moreover, I stated that patterns of intergenerational vulnerability arise when misrecognition of the twin principle is sustained throughout generations. In addition, the potential of domination arising from SRM deployment can only be avoided with a reformulated binding treaty which protects any altruistic capacity-building initiative in the future. Most importantly, the main argument, using communitarian ethics, posits that the closest proxy to satisfy an intergenerational understanding of the twin principle, respectful of future generations' rights, can be considered through a community predecessor by extension. Finally, I briefly discussed conditions for SRM research to be permissible building up from the framework set out by the Oxford Principles.

Conclusion

In this thesis, I have emphasized the relevance of scrutiny for SRM practices within the geoengineering epistemic community. More specifically, focusing on the research process that I consider as the formalization of ideation, crucial in the standardization of norms. Furthermore, I engaged with debates of intergenerational justice, ultimately refuting positive pure time discounting in favor of zero pure time discounting while borrowing elements from egalitarianism, sufficientarianism and prioritarianism to develop an ideal conception and principles of intergenerational justice. This led to an understanding of the importance of future generations' considerations within the framework of SRM research.

Theoretically, I used Hourdequin's (2019) conceptualization of the twin principle of recognition & participatory parity to assess the ethical backbone of the SRM institutional framework. I conclude that there is an institutional misrecognition and bias amongst the western-centric community of researchers due to lackluster representativeness, which affects deliberative outcomes as well as an overconfidence in their ethical expertise and modelling accuracy. I propose working towards the development of a polycentric governance which I believe better suits the complex dynamics of SRM research.

Finally, based off Hourdequin's (2019) twin principle, I contend that SRM geoengineering does not serve the interests of the present or future most vulnerable people because the formative process lacks the inclusion of recognition and participatory parity presently. As such, I build my case for an expanded version of the twin principle which incorporates intergenerational vulnerability. The updated version of the twin principle stipulates patterns of vulnerability intergenerationally if said principle is not respected over time. Also, by employing communitarian ethics, I argue in favor of present proxy representation for future generations' rights through a community-linked predecessor. Therefore, present enforceability of respect for the twin principle through the respective proxy, indirectly allows future generations' rights to be accounted for, in the hopes of contributing to an ethically comprehensive epistemic development of SRM. To finish, I highlight explicit conditions for SRM research permissibility using the cumulation of the Oxford Principles with the now intergenerational version of the twin principle with an added pre-condition of a suitable governance regime responsible for ethical oversight.

To reiterate: *What does the twin principle of participatory parity & recognition demand for future generations' rights when considering geoengineering research?*

The twin principle of participatory parity & recognition, accounting for the intergenerational factor, implies a sufficient respect of differences and participatory engagement within SRM research so as to avoid all accounts of ethnocentricity and ethical disregard for non-existent future generations. In brief, accounting for future generations' rights and interests by safeguarding representation and participation. Participatory parity should be used as a 'hub' for gradually institutionalizing recognition (Hourdequin, 2019, pp. 468-469). And cultivating a culture of recognition should be instilled as everyday practice within the epistemic SRM community (Hourdequin, 2019, p. 470).

Nevertheless, due to the scope of this paper, some limitations are inherent. The assumption of moral relevance of present and future people's rights was necessary to continue the discussion but existing theories could be used as rebuttal, discrediting the existence of moral prevalence. Moreover, discussions alluding to deliberative democracy have not been included here for the sake of space but also because it would take away from the central argument. My bias as a researcher also tends to question the assumption of deliberative democracy in essence (Reynolds, 2020, p. 7). Additionally, the relative newness of scrutiny for SRM research within the current literature led me to selecting less literature than expected as I did not find conclusive additions in other material that would aid the discussion further. Similarly, due to the creation of intergenerational vulnerability as an expanded concept, literature directly assessing the feasibility of intergenerational proxies were not found.

For further research, the plausibility of polycentric governance in accordance with SRM research should be assessed further. In addition, assessment of Caney's (2014) growth pure time discounting alongside SRM as a possible middle ground to defer some of the costs to future generations should be evaluated further as well. Finally, other ethical principles other than communitarianism should be assessed instead to develop possibly an alternate conception of proxy representation between present and future generations.

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