

Nuclear Colonization and International Security

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Introduction

The global issue of nuclear waste mismanagement has long been a subject of concern, not only for its environmental implications but also due to its consequences frequently being unevenly distributed. While nuclear power serves as a significant energy source for many countries, it generates toxic waste that remains dangerous for millennia. Unfortunately, the responsibility for managing this hazardous byproduct often falls on marginalized and Indigenous communities. These groups, already burdened by social, economic, and political disadvantages, disproportionately bear the environmental and health risks associated with nuclear waste disposal. This phenomenon, often referred to as "nuclear colonization," reflects a broader pattern of environmental racism and colonial exploitation, where the powerful prioritize their interests at the expense of vulnerable communities, effectively shifting the dangers of nuclear energy onto those who have little means to resist (Boeckers, 2019).

My internship at the Samuel Lawrence Foundation, which focuses on environmental justice issues, has deeply influenced my interest in exploring the intersection of nuclear waste mismanagement and marginalized communities. Through my work, I have seen firsthand the disproportionate environmental burdens placed on vulnerable populations, which inspired me to

investigate how these communities bear the brunt of global nuclear policies. This connection between my internship and the topic of nuclear colonization underscores the importance of addressing both the human rights violations and the systemic inequalities that persist in the nuclear industry.

This paper argues that the global mismanagement of nuclear waste is a form of nuclear colonization, where marginalized and Indigenous communities bear the brunt of the environmental and health risks. These patterns of injustice are tied to international security concerns, economic imperatives, and the structural failures of nuclear governance. In examining case studies from the U.S., Kazakhstan, and beyond, this paper explores how the global community has allowed systemic exploitation to persist while offering potential solutions that could address both the immediate risks of nuclear waste and the broader issues of environmental justice and human rights.

Nuclear Waste: Characteristics and Risks

Nuclear waste is a byproduct of nuclear energy generation, weapons testing, and medical or industrial applications. While nuclear power plants continue to be a significant energy source, the issue of waste disposal remains one of the most persistent and dangerous challenges in the field of energy production (Bunn et al., 2019). The most notable characteristic of nuclear waste is its long-lived radioactivity, which poses severe environmental and health risks for both present and future generations. There are three types of nuclear waste, high-level waste (HLW), intermediate-level waste (ILW), and low-level waste (LLW), each of which carries its own set of dangers and requires different disposal methods (Kyne & Bolin, 2016).

High-level waste is the most hazardous form of nuclear waste, primarily consisting of spent nuclear fuel from reactors. This waste is highly radioactive and can remain dangerous for thousands of years (Kyne & Bolin, 2016). HLW generates a significant amount of heat, which requires specialized storage to prevent overheating and further environmental contamination. Intermediate-level waste, which includes reactor components and other materials contaminated with radioactive isotopes, is less hazardous but still requires secure containment. Low-level waste, while less toxic, can still pose threats to human health and ecosystems if not properly managed. Although much of this waste is disposed of in shallow landfills, it remains a source of concern, particularly in the context of poorly regulated sites (Boeckers, 2019).

Nuclear waste contains a variety of radioactive isotopes, such as cesium-137, strontium-90, and plutonium-239, which emit ionizing radiation capable of damaging living tissue. These isotopes have varying half-lives, with some remaining hazardous for hundreds of thousands of years (Kyne & Bolin, 2016). The persistence of these contaminants requires long-term storage solutions that are both technologically and politically challenging. Improper disposal or containment of nuclear waste can lead to the contamination of soil, water, and air, which can have long-lasting effects on local communities and ecosystems (Höffken & Ramana, 2023).

The environmental risks associated with nuclear waste are significant, and they are exacerbated by inadequate disposal methods and a lack of political will to address the issue (Kyne & Bolin, 2016). One of the primary concerns is the potential for contamination of groundwater, which can carry radioactive materials far from their source. For example, in

areas like the Nevada Test Site and the Hanford Site in the United States, groundwater contamination from nuclear waste disposal has led to long-term environmental degradation and the potential for harm to local populations (Boeckers, 2019).

In addition to environmental concerns, nuclear waste also presents significant security risks. The presence of large quantities of radioactive materials creates opportunities for exploitation or interference, which could potentially be used to make dirty bombs or other forms of radiological terrorism (Bunn & Roth, 2019). The geopolitical implications of nuclear waste storage are also a concern. Many countries, including the United States, have chosen to store nuclear waste in remote areas, often on Indigenous lands, which can lead to conflicts over land rights, sovereignty, and environmental protection (Höffken & Ramana, 2023). This geopolitical aspect of nuclear waste management highlights how global security priorities often overshadow the rights and welfare of marginalized communities.

The human health risks associated with exposure to nuclear waste are well-documented. Radiation exposure can lead to a variety of health problems, including cancer, genetic mutations, and organ damage (Kyne & Bolin, 2016). Indigenous communities living near nuclear waste sites are particularly vulnerable to these risks, as the land is often directly associated with their way of life and cultural practices. For example, the Navajo Nation, which has been heavily impacted by uranium mining and the subsequent radioactive waste, has seen higher rates of cancer and other radiation-related illnesses among its people (Kyne & Bolin, 2016). Similarly, in regions like the Pacific Islands, where nuclear testing was conducted during the Cold War, populations have suffered from radiation-caused illnesses that continue to affect generations (Höffken & Ramana, 2023).

The health impacts of nuclear waste are not limited to physical illnesses. The psychological toll on affected communities is also significant. The constant threat of contamination and the inability to protect themselves from radioactive exposure can create a climate of fear and helplessness, further compounding the social and emotional burdens faced by these communities. This underscores the importance of addressing nuclear waste not only as a technical challenge but also as a human rights issue that affects the security and well-being of vulnerable populations (Boeckers, 2019).

Theoretical and Policy Framework

The mismanagement of nuclear waste presents a glaring human rights issue, particularly for Indigenous populations who live near waste sites or nuclear energy production facilities. These communities are often subjected to forced proximity to toxic environments and are denied the opportunity to meaningfully participate in decisions that directly affect their land and health. This is a clear violation of Indigenous sovereignty, as well as the basic human rights to health and a safe environment (Kyne & Bolin, 2016; Höffken & Ramana, 2023).

As environmental justice scholars point out, nuclear waste sites are disproportionately placed on marginalized and Indigenous lands. This form of environmental racism is exacerbated by the lack of adequate consultation or compensation. Communities near nuclear waste facilities, such as the Navajo Nation, face severe health risks such as higher cancer rates, respiratory problems, and genetic mutations (Shrader-Frechette, 2002; Kyne & Bolin, 2016). Despite these risks, these communities have little legal power or means to hold industries accountable.

International law, particularly through agencies such as the International Atomic Energy Agency (IAEA), is tasked with regulating the safe disposal of nuclear waste. However, the

IAEA's regulatory power remains insufficient, and its enforcement mechanisms tend to be weak. While the IAEA has established guidelines for nuclear waste disposal, these are often voluntary, and countries frequently ignore them in favor of cost-cutting and convenient means of disposal. The IAEA's failure to enforce regulations is a critical aspect of nuclear waste management, particularly in regions already burdened by other environmental hazards. Its voluntary safety standards and lack of binding enforcement mechanisms leave vulnerable communities at greater risk.

Recent criticisms of the IAEA have highlighted its failure to address the long-term impacts of nuclear waste storage, especially in regions already suffering from other environmental burdens. According to a report by the World Nuclear Industry Status Report (2020), the IAEA has also been slow to adopt and enforce comprehensive environmental justice frameworks within its governance, which weakens its ability to mitigate the environmental and human health risks posed by nuclear waste storage worldwide. As a result, nuclear waste policies remain skewed in favor of the economic interests of nuclear states, leaving the most vulnerable communities without adequate protection or support (Schneider et al., 2020).

The theory of "national sacrifice zones" developed by Hooks and Smith (2004) remains central to understanding the injustices of nuclear waste management. As they argue, certain areas—often populated by Indigenous and working-class communities—are designated as expendable in the pursuit of national security or economic gain. These "sacrifice zones" are where hazardous industries, including nuclear power plants and waste storage sites, are often located, leaving these communities to bear the long-term environmental and health costs (Hooks & Smith, 2004).

This dynamic also highlights the intersection between nuclear colonization and environmental justice. Communities living in these sacrifice zones are subjected to the environmental and health risks of nuclear energy generation, often with little benefit to their own development or economic stability. Instead, they are left with the lasting consequences of these industries, reinforcing existing inequalities and perpetuating cycles of exploitation. As Peebles (2011) suggests, the framing of nuclear waste as a necessary trade-off for national security or economic progress further marginalizes these communities, making it easier for governments and corporations to justify the environmental risks imposed on vulnerable populations.

Case Studies

To fully understand the scope and depth of nuclear waste mismanagement and its disproportionate impacts on marginalized communities, it is essential to examine specific case studies. These examples illustrate how communities globally continue to face environmental and health risks due to the practices surrounding nuclear waste disposal and testing. Through a closer look at the U.S., Kazakhstan, the Pacific Islands, and Africa, we can better understand the patterns of exploitation, the global impact of nuclear policies, and the link between nuclear colonization and environmental injustice.

A. San Onofre, USA

The San Onofre Nuclear Generating Station (SONGS), located in Southern California, has become one of the most talked-about examples of nuclear waste mismanagement in the U.S. After closing in 2013, the facility quickly became a focal point for concerns about the long-term safety of nuclear waste storage. With more than 3.6 million pounds of spent nuclear fuel stored on-site, San Onofre now holds one of the largest stockpiles of nuclear waste in the country

(Samuel Lawrence Foundation, n.d.). The waste is kept in dry cask storage canisters made of stainless steel, but these have been heavily criticized for being vulnerable to corrosion and seismic activity. Experts are particularly concerned because the site sits near active fault lines and the Pacific Ocean, making it prone to natural disasters that could compromise storage safety (Samuel Lawrence Foundation, n.d.).

The issues surrounding San Onofre go beyond just the immediate risks of waste storage. The U.S. government's failure to come up with a permanent solution for nuclear waste highlights just how broken the system is. Communities near nuclear waste storage sites, such as those in Southern California, are left with no way to address the long-term risks posed by waste stored in their backyards. This lack of action by government and industry speaks to a deeper problem of nuclear colonization, where the most vulnerable communities bear the risks while powerful corporations and government bodies benefit from nuclear energy (Samuel Lawrence Foundation, n.d.). Additionally, the San Onofre case shows how public perception and media framing shape how we think about nuclear waste. As Peeples (2011) points out, nuclear waste is often presented as a necessary evil, a trade-off for energy production, which helps downplay the real risks and discourages resistance. At San Onofre, the narrative of "safe storage" has been pushed by both the government and the companies involved, even though evidence shows the site's proximity to seismic zones poses a serious risk. This framing is key to maintaining the political and economic interests of nuclear industries, even if it means ignoring the health and safety of vulnerable communities (Samuel Lawrence Foundation, n.d.).

Interning at the Samuel Lawrence Foundation has only reinforced my belief that cases like San Onofre are glaring examples of environmental injustice. The continued reliance on outdated

storage methods and the lack of meaningful regulation only make existing inequalities worse. Marginalized communities and especially Indigenous ones, are left to deal with the consequences of nuclear power policies without any meaningful protection or compensation. The San Onofre situation not only highlights the failures of nuclear governance but also exemplifies how the mismanagement of nuclear waste perpetuates nuclear colonization, where those least able to fight back continue to suffer the most (Samuel Lawrence Foundation, n.d.).

B. Kazakhstan

Kazakhstan's Semipalatinsk Test Site, one of the largest nuclear test sites of the Soviet Union, provides a powerful example of the environmental and health risks associated with nuclear weapons testing. Between 1949 and 1989, over 450 nuclear tests were conducted in this region, exposing local populations, particularly Indigenous Kazakhs, to radiation. These tests led to severe health issues, including cancer, birth defects, and other genetic disorders, with evidence of contamination being widespread, particularly in the southeast Abai oblast (Akhmetova et al., 2024). The government, however, failed to adequately compensate or support the affected communities.

The legacy of nuclear testing in Kazakhstan highlights the ongoing consequences of Cold War-era nuclear policies, where marginalized populations were knowingly exposed to the dangers of radiation with little regard for their health or safety. The government's lack of accountability for the environmental damage caused by these tests is representative of a global pattern where Indigenous and vulnerable communities bear the brunt of nuclear industries' harmful practices. Moreover, Kazakhstan's post-Soviet efforts to clean up the region have been insufficient, leaving communities to deal with the long-term consequences of contamination (Akhmetova et al., 2024;

Lipikhina et al., 2025).

The environmental consequences of the Semipalatinsk tests include widespread radioactive contamination in soil and water bodies, which has severely impacted local ecosystems and contributed to rising health complications among the population. The areas most affected by radiation included the villages of Makanchi, Urdzhar, and Taskesken, which were subjected to fallout from atmospheric tests conducted at the Lop Nor nuclear test site in China between 1964 and 1980 (Lipikhina et al., 2025). The most reliable data, including soil and radiation measurements, show that radiation levels in these areas were much higher than normal levels found around the world, which contributed to the health risks faced by local communities (Akhmetova et al., 2024).

Despite some local and international efforts to mitigate the effects of radiation, such as environmental monitoring and rehabilitation measures, the cleanup efforts have not been comprehensive or effective enough to address the scale of contamination (Akhmetova et al., 2024). As a result, affected communities continue to struggle with both the environmental degradation and the ongoing health risks associated with the legacy of nuclear testing.

C. Pacific Islands

The Pacific Islands, particularly the Marshall Islands, have been a major site for nuclear testing, with the United States conducting over 67 nuclear tests between 1946 and 1958. These tests caused widespread contamination, leading to long-term health issues such as cancer, thyroid disease, and birth defects among the Marshallese people (Patel, 2024). Despite promises of compensation, the people of the Marshall Islands continue to suffer from the environmental and health consequences of the tests. The U.S. government's failure to adequately address the ongoing

issues, including radiation exposure, demonstrates the global inequities in the treatment of Indigenous populations and the continued disregard for their rights and health (Patel, 2024).

The situation in the Pacific Islands also speaks to the broader issue of nuclear colonization, as the U.S. treated these islands as expendable territories, conducting dangerous nuclear tests without regard for the long-term impacts on local communities. This disregard for Indigenous sovereignty and health reflects a larger pattern in which powerful nations exploit vulnerable regions for their nuclear agendas (Patel, 2024). The Marshallese people were exposed to both immediate radiation burns and long-term health risks, and despite the continued fallout from these tests, they remain without proper compensation or significant health support (Patel, 2024).

Moreover, long-term studies have documented the severe genetic effects of radiation exposure, such as an increased incidence of cancers, including thyroid and breast cancers, as well as hematologic malignancies among those who lived in proximity to the test sites (Patel, 2024). These effects have not only impacted individuals directly exposed to radiation but also their offsprings, who suffer from genetic mutations that increase their risk for various diseases (Patel, 2024). The environmental consequences of the nuclear tests are also severe, with large portions of the Marshall Islands remaining uninhabitable due to high radiation levels (Patel, 2024).

The U.S. government's response has been insufficient, and communities in the Marshall Islands continue to face significant health care barriers, including a lack of access to cancer treatment and mental health support. The psychosocial impacts of nuclear testing—ranging from displacement and loss of cultural identity to trauma from exposure—continue to affect the people of the Pacific Islands today (Patel, 2024). The legacy of these tests highlights the need for justice,

as well as a deeper acknowledgment of the long-term damage caused by the nuclear tests in this region.

D. Africa

Africa has been deeply involved in the global nuclear industry, particularly through uranium mining in countries like Niger, Namibia, and South Africa. These countries are rich in uranium, which is essential for nuclear energy production, yet local populations living near the mines are exposed to high levels of radiation, leading to serious health risks such as cancer, respiratory diseases, and other radiation-related illnesses (Unal et al., 2017; Cawood & Friend, 2005). The exploitation of Africa's uranium resources highlights the continued legacy of colonialism, where African nations are used as sources of raw materials while their people bear the environmental and health costs of these industries (Unal et al., 2017). This is compounded by the lack of adequate compensation or assistance for affected communities (Unal et al., 2017).

In Namibia, for example, local communities near uranium mines have faced environmental degradation and health problems due to radiation exposure. These communities have received minimal support or compensation from the international community or the corporations profiting from these resources (Cawood & Friend, 2005). The ongoing environmental contamination in mining areas, such as the Rossing uranium mine, has led to increased rates of lung diseases, cancers, and birth defects (Cawood & Friend, 2005). The lack of accountability from both mining corporations and the Namibian government further highlights the stark inequality between resource-rich countries and the global north that benefits from these resources without addressing the health and environmental consequences for local populations (Cawood & Friend, 2005).

This exploitation of African resources is part of a larger global structure where wealthy nations reap the benefits of nuclear energy while the people of resource-rich, often marginalized, nations suffer the consequences. As Unal et al. (2017) point out, this dynamic reinforces the structural inequality that underpins nuclear colonization, where Africa's role in the nuclear industry is characterized by exploitation rather than mutual benefit.

Solutions and Policy Recommendations

Addressing the urgent issue of nuclear colonization requires a comprehensive approach that tackles not only the immediate dangers of nuclear waste but also the deeper, systemic inequalities that have long burdened marginalized and Indigenous communities. The following recommendations outline strategies to reduce the harmful impacts of nuclear waste mismanagement while advancing environmental justice and ensuring that marginalized communities are both protected and empowered.

The mismanagement of nuclear waste is deeply intertwined with the lack of substantial international oversight. The International Atomic Energy Agency (IAEA), which is responsible for setting guidelines on nuclear safety and waste management, has been criticized for its failure to implement and enforce comprehensive and binding regulations. To effectively address the risks associated with nuclear waste, particularly its disproportionate impact on marginalized communities, the IAEA must undergo significant reforms. This should include the establishment of legally binding regulations for nuclear waste disposal, with strict enforcement mechanisms to hold states accountable for compliance.

Additionally, there needs to be a reevaluation of the IAEA's guidelines, ensuring they are based on environmental justice principles. These revisions should prioritize the protection of Indigenous lands and communities, requiring full consultation and the active involvement of affected groups in decision-making processes. Such reforms would ensure that nuclear waste policies are not only environmentally sound but also socially just, allowing for a more equitable distribution of risks and benefits. Indigenous sovereignty must be respected, and the historical and ongoing exploitation of these communities must be addressed through targeted policies that affirm their right to self-determination and environmental protection.

One of the most critical components of addressing nuclear colonization is the recognition of the rights and sovereignty of Indigenous and marginalized communities. As noted, these groups have borne the brunt of nuclear waste mismanagement, suffering severe environmental and health consequences with minimal support or compensation (Boeckers, 2019). Policy solutions must, therefore, include compensation for communities affected by nuclear waste due to the lasting damage caused by nuclear testing and waste storage.

While immediate steps to address the social justice aspects of nuclear waste are critical, long-term solutions are necessary to prevent future harm. Improved methods of nuclear waste storage must be developed, particularly in regions where existing infrastructure is inadequate or vulnerable to natural disasters. For example, the situation at the San Onofre Nuclear Generating Station (SONGS) in Southern California, where nuclear waste is stored in dry cask containers vulnerable to corrosion and seismic activity, underscores the need for more secure and sustainable storage solutions.

Long-term solutions should also focus on the development of safe, permanent disposal methods, such as deep geological repositories. These repositories should be carefully selected to avoid areas prone to natural disasters or geopolitical tensions. Moreover, the siting of waste storage facilities must take into account the rights and concerns of local communities, with a preference for regions that do not disproportionately affect marginalized or Indigenous populations. The principle of "environmental justice" must guide these decisions, ensuring that no community bears an unjust burden of nuclear waste storage.

Conclusion

The ongoing mismanagement of nuclear waste is a pressing global issue that disproportionately affects marginalized and Indigenous communities. Nuclear colonization is a clear manifestation of environmental racism, where powerful nations and corporations impose the dangerous consequences of nuclear energy production on vulnerable populations. These communities bear the brunt of both the environmental and health risks while being largely excluded from the decision-making processes that affect their lives and land. Addressing this issue requires comprehensive reforms to international governance, a commitment to environmental justice, the development of sustainable waste storage solutions, and greater transparency in nuclear waste management practices. It is imperative that the international community adopts a human rights framework in its approach to nuclear waste, one that acknowledges the historical and ongoing exploitation of marginalized communities. This framework should center the voices of those most impacted, ensuring that their rights, health, and safety are prioritized. Through meaningful reforms and policy changes, we can work toward a future where nuclear waste management is not only safe and effective but also just and equitable.

for all, fostering a world where no community is left to bear the costs of nuclear energy alone.

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