NUCLEARIZATION AND ENVIRONMENTAL JUSTICE: REFLECTIONS ON THE IMPACT ON INDIGENOUS PEOPLES

B.R. CARVALHO
Universidade de Brasília
Brasilia, Brazil
Email: beatrizrodriguescarvalho@gmail.com

E.A. RODRIGUES
Nuclear and Energy Research Institute IPEN – CNEN | Environmental Research Institute IPA
São Paulo, Brazil

Abstract: This study investigates the adverse impacts of nuclear activities on indigenous populations and identifies strategies for environmental justice. The systematic literature review involved the analysis of 57 articles selected from the Web of Science database. The spatial and historical analysis of nuclear energy reveals a systemic interconnection that ranges from uranium mining to nuclear waste disposal, influencing the global dynamics of supply and demand. The research identified that uranium mining and nuclear waste disposal take place predominantly on indigenous lands, exposing these communities to health risks, environmental degradation and socio-cultural disruption. The United States, Canada and Australia are the main focus of the investigations, with little research in other regions. The study highlights the need for inclusive policies that consider the perspectives of indigenous communities in decision-making processes related to nuclear energy and emphasizes the importance of community engagement and social impact assessment to mitigate negative effects on indigenous populations. The study concludes that although there has been a recent increase in academic interest in these impacts, the amount of research is still limited, especially considering the extent of nuclear operations on indigenous lands.

1. INTRODUCTION

Nuclear power has been an important source of low-carbon energy for decades and its development is considered essential to achieve energy security and climate objectives (Yang and Xue, 2022; Liu et al., 2023; Carvalho et al., 2024). However, its optimization in the energy framework is complex due to its characteristics involving multiple domains, objectives, time scales, spatial scopes and long time periods; as well as generalized physical elements (nuclear energy chain, non-nuclear energy systems and climate system), social elements (policies and public acceptance) and cyber elements (integration between domains of information acquisition, knowledge extraction and decision support) (Yang and Xue, 2022).

The urgency to generate low-carbon energy (UNFCCC, 2024; IPCC, 2023) reinforces the role of nuclear energy in providing safe and reliable electricity - throughout 2021, 437 operational nuclear reactors in 32 countries generated around 10% of the global electricity production and more than a quarter of the world's low-carbon production (IAEA, 2022).

In addition to nuclear power plants having great potential in non-electric applications (such as district heating, hydrogen production and desalination), the development of advanced and emerging nuclear technology, such as microreactors and small and medium modular reactors (SMRs), increases the potential use of nuclear energy (Liu et al, 2023; Hussein, 2020; Black et al. 2023)

While the projections for increased nuclear energy production imply a respective expansion in uranium extraction (Graetz, 2014), it is necessary to consider that both the beginning and end of the nuclear fuel chain primarily occur on Indigenous lands. It is estimated that 70 percent of the world's uranium is located on Indigenous lands across nearly all continents (LaDuke, 1999; Graetz, 2015; Runyan, 2022). Recent changes in the natural uranium market also introduce new challenges for regulation, physical protection, export controls, and tracking of raw materials, such as processed uranium concentrates. While traditional consumers are moving away from nuclear energy (such as Japan and Germany), ambitious nuclear energy programs in China and Russia could increase global demand for uranium, with new suppliers entering the global market, including Malawi, Tanzania, and Greenland (Vestergaard, 2015).

The adverse impacts of nuclear activities on Indigenous populations are multiple and include health risks from radiation exposure, environmental degradation, and socio-cultural disruptions. Despite these significant concerns, there is a notable gap in the comprehensive understanding and documentation of these impacts.

This study aims to fill these gaps by systematically reviewing existing literature to investigate the adverse impacts of nuclear activities on Indigenous populations and to identify strategies and opportunities for environmental justice. By focusing on both the physical and socio-cultural dimensions of these impacts, this research seeks to contribute to a more nuanced understanding of the intersection between nuclear energy production and Indigenous rights.

Furthermore, the study aims to highlight the need for inclusive policy frameworks that consider the perspectives of Indigenous communities in decision-making processes related to nuclear energy. By doing so, it intends to contribute to the broader discourse on sustainable and equitable energy transitions, emphasizing the importance of justice and equity in environmental governance. This research will not only inform policymakers and stakeholders but also advocate for the rights and well-being of Indigenous peoples in the context of nuclear energy development.

2. METHODOLOGY

A systematic literature review was carried out, searching the Web of Science (WoS) scientific database on Jun 26, 2024, with registration and institutional access by the University of São Paulo. The aim of the search was to select articles that address the adverse impacts of nuclear activities on Indigenous populations. The search string defined in TABLE 1 was used.

TABLE 1. SEARCH STRING USED IN THE SCIENTIFIC DATABASE WEB OF SCIENCE, ON JUNL 26, 2024.

("Aboriginal land*") or ("Indian*" OR "indigenous peopl*" OR "indigenous communit*" OR "native peopl*" OR "aboriginal peopl*" OR "first nation*" OR "nativ*" OR "first peopl*")

The choice of the scientific database WoS as a research source was based on its credibility, interdisciplinary coverage, access to updated and reliable information; and advanced search resources, which provide quality and relevance to the information collected for the review. The search identified 508 records, which were analyzed in their title, abstract and keywords to identify convergence with the theme of the study, which resulted in the selection of 59 studies.

After identifying the studies, they were analyzed in their entirety, considering as criteria the availability of the complete article for consultation and its suitability for the research topic. The results were systematized in an Excel spreadsheet. The analysis was carried out by two members of the research team. Assessments were performed independently to reduce individual bias and increase the reliability of the review. If there was disagreement between the two evaluators, prevailed the result pointed out by the member with the most experience in the subject. Of the fifty nine articles found, two were excluded. The 57 resulting articles were subjected to a new complete reading, and they were kept for technical analysis.

This work explores the use of VOSviewer for descriptive analyses in the context of research scope. Graphical representations are essential for simplifying complicated datasets because they provide a visual story that improves comprehension and makes for perceptive interpretations. Graphs are an essential tool for descriptive analysis in research, especially in domains that are interdisciplinary and involve both industry and academics. They help researchers identify patterns, relationships, and trends in their data. VOSviewer is a very effective and adaptable tool designed for the visualisation and exploration of large-scale bibliometric and scientometric data, making it stand out among the many graphing techniques available.

A TXT and XLS file was exported from the WoS database with complete metadata records of the 57 articles included in the review. For the bibliometric analysis, the keywords described by the authors themselves were selected, out of a total of 182 terms. The conceptually equivalent terms were grouped together (Table 1), resulting in 159 keywords for analysis. This grouping was necessary so that original terms written in different ways could be properly analyzed.

TABLE 1. AUTHORS' KEYWORDS INCORPORATED INTO THE SAME LABEL FOR CO-OCCURRENCE ANALYSIS

Label	Incorporated terms
aboriginal peoples	Aboriginal, aborigines and Australia, australian aboriginal,
uranium mining	Uranium, uranium mines, uranium mining and culture,
nuclear waste	radioactive waste, tailings, tailings-uranium,
occupational health	occupational disease illness, occupational lung disease
navajo nation	navajo nation, Navajo
native american	native americans, american Indian
miners	miner health, millworkers
kakadu	Kakadu, kakadu national park

indigenous people	indigenous peoples, indigenous women, indigenous feminism,
ethnobotanical plants	ethnobotanical plants, herbal remedies
environmental impact	environmental impact, environmental impact assessment
community engagement	community engagement, community consultation

For the keyword co-occurrence analysis, keywords that co-occur more frequently and have a higher link strength were identified. Thus, keywords with a minimum occurrence of two times and a minimum link strength of two were considered, resulting in 24 matches.

3. RESULTS AND DISCUSSION

3.1. Spatial and historical dimensions of nuclear energy

The development of nuclear technologies for energy generation, weapons manufacturing, food preservation and medical procedures has multiplied the places intertwined by the nuclear industry in an uneven atomic complex, from uranium mining; the planning, construction and operation of nuclear power plants; public acceptance or resistance; the decommissioning of nuclear facilities; the evolution of research centers; political control and the storage of nuclear waste (Gutting et al., 2024).

With a history marked by significant advances and significant setbacks since the 1950s, nuclear energy has enjoyed a renaissance of public attention since 2022. Driven by the energy price crisis, extreme weather events and the large-scale invasion of Ukraine by Russia, this renaissance has favored the current increase in the price of uranium, which has already led to the reopening of mines (Meyer and Sérandour, 2024).

Although the concept of a "cycle" can be criticized for the difficulty of finding truly cyclical characteristics of nuclear energy in a global scenario, this "supply chain (Hill and Ashipala, 2024) usually referred to as the "nuclear fuel cycle" begins with the exploration and mining of uranium and ends with the disposal of nuclear waste. Uranium extracted from nature needs to go through several stages before it is suitable for use in a nuclear reactor, the typology of which defines the additional stages of uranium processing, which can include processing, refining, conversion, enrichment, deconversion and fuel fabrication. The stages prior to loading the nuclear fuel into the reactor constitute the initial phase of this cycle and can take two to three years to complete. After the uranium has spent up to five years in a reactor core to produce electricity, the spent fuel can undergo a further series of steps, which include temporary storage, reprocessing and recycling. Nuclear waste is destined for temporary (short-term or long-term) disposal and is known as the "end" of the fuel cycle (IAEA, 2023).

Natural uranium is sold directly by primary producers or traded through a series of intermediaries, and its production is highly concentrated in geographical and commercial terms - in 2021, 93% of the uranium mined was supplied by seven countries (Australia, Canada, Kazakhstan, Namibia, Niger, Russia and Uzbekistan), while 89% was controlled by the ten largest mining companies (IAEA, 2023) (Figure 1).

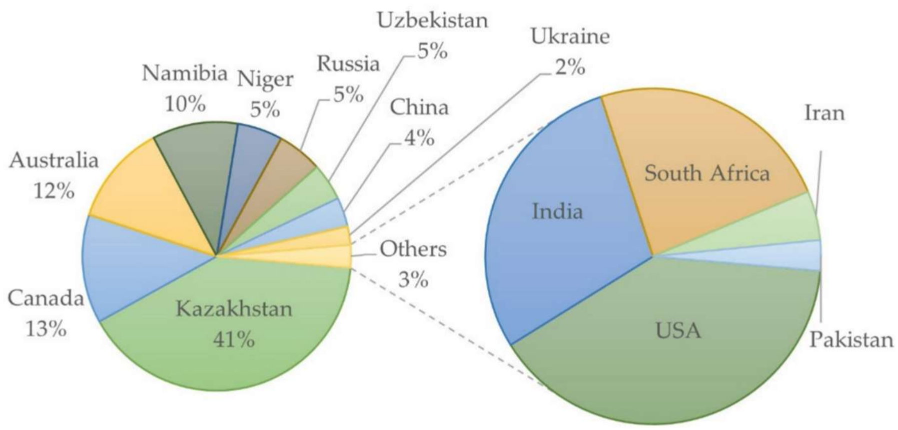

FIG 1: Distribution of worldwide uranium production in 2018 (Alwaeli and Mannheim, 2022)

In the period 1945-1990, the military acquisition of uranium was a significant (and even dominant) part of world demand. However, since 1990, the reduction of nuclear arsenals has been an important element in the continued supply of uranium for commercial and non-weapons purposes, with the greatest demand today being for the supply of nuclear fuel components for civil nuclear power, which is almost entirely dedicated to electricity generation (IAEA, 2023) (Figure 2).

Operational, economic and political factors can influence the availability of resources and can be compounded by the relative distribution of subsequent processing steps for the conversion, enrichment and deconversion stages (IAEA, 2023).

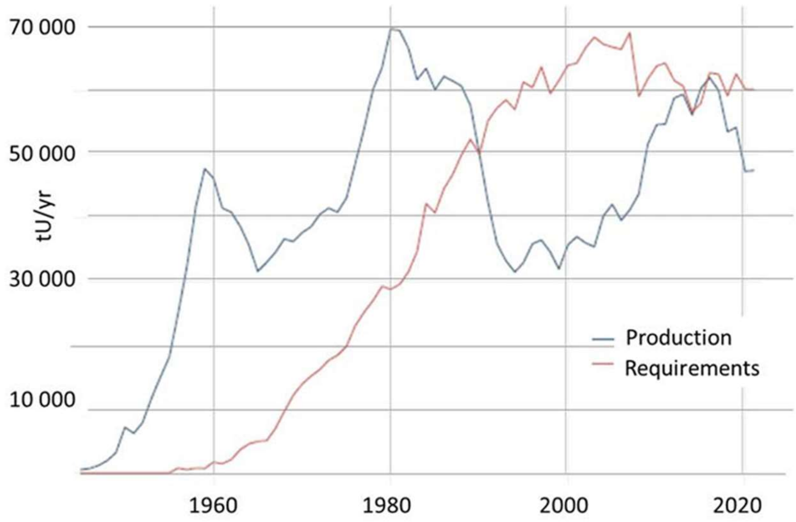

FIG 2: World Annual Uranium Production and Civil Nuclear Requirements (1949-2021) reproduced from IAEA (2023: 2)

All these aspects highlight the spatial-systemic interconnection and show that nuclear energy is much more than nuclear power plants as it encompasses the mining and milling of uranium, its conversion and enrichment, reprocessing of spent nuclear fuel, radioactive waste management; as well as transportation of uranium, nuclear fuel and radioactive waste and extensive research and development complexes around the world (Gutting et al, 2024).

This approach expresses the geographies of nuclear energy, as well as nuclearity as a socially constructed category that marks objects, places or dangers as "nuclear" in techno-scientific, political or medical terms (Hecht, 2010) and multidimensional since the factors that constitute it are contingent on actors who evolve in particular historical and geographical contexts and who perceive political opportunities in the nuclearization of a place (Meyer, 2024).

From the perspective of Social Sciences, in an analysis of the spatial dimensions of nuclear energy that considered a review of 205 articles, including case studies (65%); review articles (18%); and studies conducted on a national scale (18%), of the 133 publications that used case studies, around 48% concern nuclear power plants, followed by studies on spent fuel disposal (17%); nuclear weapons production sites (10.8%); uranium mines (8.5%); nuclear test sites (8.5); and the transformation of uranium into nuclear fuel, with studies restricted only to the conversion stage (1.7%). The transportation of uranium products has not been studied, nor have studies on reactor supply chains. The disposal and reprocessing of spent nuclear fuel is only slightly discussed (0.6%), while less radioactive nuclear waste is not studied. Although there are 840 research reactors in 70 countries, this infrastructure has been studied in less than 2.5% of the articles; while non-energy applications of the atomic complex are absent, including medical uses or industrial and agricultural applications (Meyer and Sérandour, 2024).

In addition to this thematic concentration, nuclear geography is also spatially limited. 193 studies were identified spread across 27 countries - around 35% of these sites are in the USA; 8.5% in the UK; 7.5% in Japan; 5% in Canada and Ukraine; 4.5% in Lithuania; and 4% in Germany and Finland. With the exception of the research reactor in Ghana and the uranium mines in Namibia and South Africa, African countries are almost entirely absent from the studies. The spatial dimensions of justice were addressed in four studies, which focused on nuclear sites and particularly uranium mines and waste management sites as examples to investigate distributive spatial injustice; while thirteen studies described the spatial inequalities of the atomic age as a space of coloniality in which nuclear development is based on the disproportionate destruction of indigenous peoples and their lands (Meyer and Sérandour, 2024). These gaps, with evidence of thematically and geographically concentrated scientific production, direct the systematic review on the impact of the nuclear agenda on indigenous communities.

3.2. Nuclear spaces and environmental justice on indigenous lands

A chronological analysis of the 57 articles that studied the impact of the nuclear industry on indigenous populations reveals a significant growth in academic interest and public concern over the decades. In the 1970s and 1980s, the gradual increase in publications reflects the initial growth of the nuclear industry and the impacts of nuclear tests, which began to receive greater attention for their adverse effects on indigenous populations and the environment. Events such as the Chernobyl disaster in 1986 catalyzed a focus on safety issues and the socio-environmental impacts of uranium mining, with an emphasis on the need for stricter regulations and greater awareness of the consequences for vulnerable communities (Figure 3).

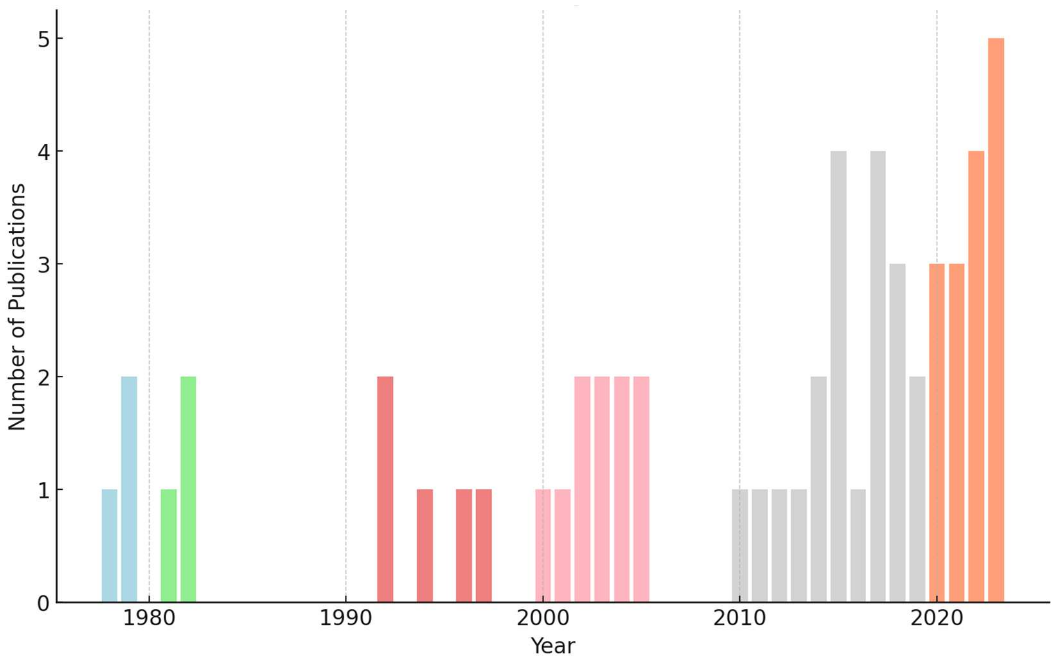

FIG 3: Trend of publications from 1978 to 2024 covering the impact of nuclear activities on indigenous peoples

In subsequent decades, especially since the 2000s, there has been a stabilization and continuous increase in the number of publications, in growing recognition of the necessary debate on nuclear safety and environmental justice, which resulted in a peak of publications in the 2010s. In addition, the development of new technologies and the search for sustainable energy solutions have also boosted research into the environmental and social impacts of the nuclear industry. This relatively continuous and diverse increase in publications highlights the growing awareness of the disproportionate impacts suffered by indigenous populations and the need to address issues of environmental justice and sustainability in the context of nuclear energy.

However, in absolute terms, the identification of only 57 published studies that directly relate the impacts of nuclear energy on indigenous peoples over a period of five decades also shows how incipient this thematic still is, especially given the estimate that, in the United States and Canada alone, at least two thirds of the domestic supply of uranium is found on indigenous lands (Runyan, 2022).

This work explores the use of VOSviewer for descriptive analyses. By harnessing its capabilities, the aim is to highlight the intricacies of the findings, providing readers with a comprehensive visual representation that complements the textual discussions, including co-authorship networks, co-citation maps, and keyword co-occurrence clusters, with emphasis on the temporal evolution of issues related to uranium mining and its impacts (Figure 4).

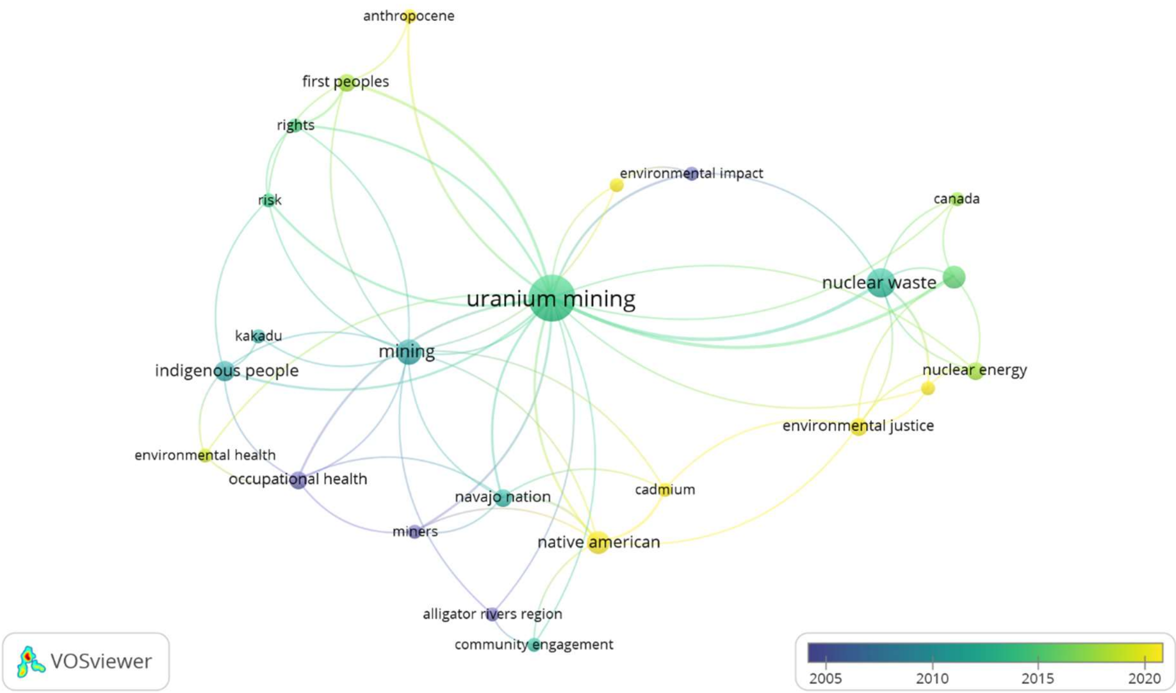

FIG 4. Network Graph of co-occurrence between keywords.

The keyword co-relation analysis identified six clusters. Uranium mining appears as the oldest central theme, and reflects its continuous and predominant role in the studies reviewed. Over time, nuclear waste disposal has become increasingly relevant in the literature. Environmental justice and environmental impact, represented by more recent colors, suggest a recent increase in awareness and research on the equitable distribution of environmental impacts and the mitigation of ecological damage, which reinforces the importance of fairer and more inclusive public policies.

The impact of uranium mining on indigenous peoples, highlighted by the terms "indigenous people", "native American" and "first peoples", with evidence of the adverse effects of these activities on vulnerable communities. Community engagement was also emphasized as areas of more recent research, while occupational and environmental health, represented by intermediate colors, reflect ongoing concerns about the risks faced by both workers and communities near mining operations. The figure also highlights specific geographic terms, such as Kakadu and Navajo Nation, indicating that these studies often focus on particular cases where the impacts of uranium mining are especially significant.

In an analysis of the distribution of the different countries that were the focus of the studies included in this review, out of a total of 65 occurrences, the United States is the country that is the subject of most of the investigations (46.%), followed by Canada (21.5%), Australia (20%) and Namibia (3.1%). Arctic countries, Denmark, the Marshall Islands, Nigeria, Norway and Russia have only one study in each country.

TABLE 2. STUDIES ON THE IMPACTS OF NUCLEAR ACTIVITIES ON INDIGENOUS LANDS

Country	Povo indígena	Author
United States	Navajo	Stephenson (1978); Moody (1979), Nelkin (1981), Bregman (1982), Gottlieb and Husen (1982), Dawson (1992), Shiels et al (1992), Gilliland et al (2000); Mulloy et al. (2001), Dawson and Madsen (2011), Barker (2015), Hund et al. (2015), Jones (2017), Samuel-Nakamura et al (2019), Tillman et al (2020), Ingram et al. (2020). Collier et al. (2020), Samuel-Nakamura and Ali (2022), Coombs et al (2022), Erdei et al. (2023)
	Laguna Pueblo	Moody (1979), Nelkin (1981), Bgregman (1982)
	Hualapai Tribe	Tillman et al (2020), Tillman et al. (2021)
	Mescalero Apache	Shrader-Frechette (1996)
	Havasupai Nation	Tillman et al. (2021)
	Goshute Nation	Ishiyama (2003)
	Spokane	Barker (2015), Flett al al ()2021

	Yakima	Barker (2015)
	Nez Perce	Barker (2015)
	Umatilla	Barker (2015)
	Shoshone	Barker (2015)
	Numic	Stolfle and Arnold (2003)
Canada	Inuit	Moody (1979), Sarkar (2019)
	Dene	Heber (2005), Keeling (2010), Haalboom (2014; 2016), May (2022)
	Saugeen Ojibway Nation	Runyan (2018), Runyan (2022)
	Cree	Keeling (2010), Haalboom (2014; 2016)
	Métis	Keeling (2010), Haalboom (2014; 2016)
	Anishinaabe	Stanley (2008), Runyan (2022)
Australia	Mirrar	Aplin (2004), Hart et al. (2015), Graetz (2015), Lea et al. (2018)
	Kokotha	Gester (2013)
	Yankunytjatjara	Hall (2018)
	Maralinga Tjarutja	Hall (2018)
	Pitjantjatjara,	Hall (2018)
	Adnyamathanha	Green (2017), Marsh and Green (2020)
Norway	Sami	Jackson et al (2023)
Marshall Islands	Dri-Enewetak	Davisson et al. (2012)
	Bikini	Barker (2015)

Graetz (2014) was the most comprehensive study in systematizing the major global uranium developments, the operator details of each site and the indigenous groups affected in Australia, Canada, United States, Namibia and Niger. The article documented mainly negative encounters of indigenous peoples with uranium development, and postulates the necessary and urgent rethinking of the practice of community engagement with indigenous peoples, broader community relations and the use of social impact assessments to identify unwanted impacts of developments and opportunities for their mitigation (Graetz, 2014).

In addition to the peoples systematized in Table 2, studies have been carried out on the impact of uranium on other indigenous populations inhabiting Canada (Sass, 1994; Chauhan et al. 2021); the southwestern United States (Mapel et al., 1997), the Grand Canyon region (Mueller et al. (2017) and other regions of the United States (Fegadel, 2023); northern Australia (van Dam et al., 2002; Waggitt, 2004; Ryan et al., 2005); the Arctic (Strand et al., 2002), Transbaikalia province in eastern Siberia (Mamontova, 2023) and nuclear energy and environmental injustice without analyzing any specific people or country (Hoffken et al., 2024).

4. CONCLUSIONS

The study examined the adverse impact of nuclear activities on indigenous populations, with a focus on environmental justice. Through a systematic literature review, evidence was found that nuclear operations, especially uranium mining and nuclear waste disposal, predominantly take place on indigenous lands, exposing these communities to health risks, environmental degradation and socio-cultural disruptions. There was also a lack of research into the impacts of other nuclear-related activities on indigenous peoples. With a comprehensive analysis of 57 articles, it was found that although there has been a recent increase in academic interest in these impacts, the amount of research is still limited, especially when considering the extent of nuclear operations on indigenous lands

It is crucial to adopt inclusive policies that embrace the perspectives of indigenous communities in decision-making processes related to nuclear energy, in order to promote fairer and more sustainable energy transitions. Greater community engagement and social impact assessment to mitigate the negative effects on indigenous populations is a fundamental condition for achieving environmental governance.

The limitation of the descriptors used and the exclusivity of the Web of Science database, which may have restricted the scope and diversity of the studies carried out, constitute research biases. To mitigate these biases, future research will be conducted by expanding the descriptors, including multiple databases and data sources, in order to build a more global view of the impacts of nuclear activities on indigenous peoples.

ACKNOWLEDGEMENTS

The authors thank CAPES and the support of Postgraduate Program in Nuclear Technology (IPEN-CNEN).

REFERENCES

Alwaeli, M., & Mannheim, V. (2022). Investigation into the current state of nuclear energy and nuclear waste management—a state-of-the-art review. Energies, 15(12), 4275. https://doi.org/10.3390/en15124275

Aplin, G. (2004). Kakadu National Park World Heritage Site: Deconstructing the Debate, 1997–2003. Australian Geographical Studies, 42(2), 152-174.

Barker, H. M. (2015). Confronting a Trinity of Institutional Barriers: Denial, Cover-Up, and Secrecy. Oceania, 85(3), 376-389.

Black, G., Shropshire, D., Araújo, K., & van Heek, A. (2023). Prospects for nuclear microreactors: a review of the technology, economics, and regulatory considerations. Nuclear Technology, 209(sup1), S1-S20.

Bregman, S. E., & Cormick, G. W. (1982). Uranium Mining on Indian Lands: Blessing or Curse?. Environment: Science and Policy for Sustainable Development, 24(7), 6-33. http://dx.doi.org/10.1080/00139157.1982.9929801

Carvalho, A.R., Andrade, M.V., Rodrigues, E.A., CARVALHO, B.R., Andrade, D.A., Bustillos, J.O.W.V., & Toro F.A.R., Nuclear security and safety: a systematic review of climate-resilient measures. *In:* International Conference on Nuclear Security: Shaping the future 2024 - CONS 2024, 20-24 May 2024, Vienna, Austria

Chauhan, V., Leblanc, J., Sadi, B., Burtt, J., Sauvé, K., Lane, R., ... & Quayle, D. (2021). COHERE–strengthening cooperation within the Canadian government on radiation research. International Journal of Radiation Biology, 97(9), 1153-1165.

Collier, A. F., Tidikis, V., Blackhorse, D., Skabelund, S., Tannous, J., & Benally, M. (2020). Giving voice to the impact of environmental-associated trauma in indigenous people through social practice art. Journal of Humanistic Psychology, 0022167820902954.

Coombs, S., Sleeth, D. K., & Jones, R. M. (2022). Environmental and occupational health on the Navajo Nation: a scoping review. Reviews on Environmental Health, 37(2), 181-187.

Davisson, M. L., Hamilton, T. F., & Tompson, A. F. (2012). Radioactive waste buried beneath Runit dome on Enewetak atoll, Marshall Islands. International Journal of Environment and Pollution, 49(3-4), 161-178.

Dawson, S. (1992). Navajo uranium workers and the effects of occupational illnesses: A case study. Human Organization, 51(4), 389-397. http://dx.doi.org/10.17730/humo.51.4.e02484g513501t35

Dawson, S. E., & Madsen, G. E. (2011). Psychosocial and health impacts of uranium mining and milling on Navajo lands. Health physics, 101(5), 618-625.

Erdei, E., Shuey, C., Miller, C., Hoover, J., Cajero, M., & Lewis, J. (2023). Metal mixture exposures and multiplexed autoantibody screening in Navajo communities exposed to uranium mine wastes. Journal of Translational Autoimmunity, 6, 100201.

Fegadel, A. R. (2023). Green victimization of native Americans: uranium mining as a form of toxic colonialism and genocide. Critical Criminology, 31(2), 489-505.

Flett, L., McLeod, C. L., McCarty, J. L., Shaulis, B. J., Fain, J. J., & Krekeler, M. P. (2021). Monitoring uranium mine pollution on Native American lands: Insights from tree bark particulate matter on the Spokane Reservation, Washington, USA. Environmental Research, 194, 110619.

Gerster, R. (2013). Down the yellowcake road: the minefield of Australian uranium. Journal of Australian Studies, 37(4), 438-450.

Gilliland, F. D., Hunt, W. C., Pardilla, M., & Key, C. R. (2000). Uranium mining and lung cancer among Navajo men in New Mexico and Arizona, 1969 to 1993. Journal of Occupational and Environmental Medicine, 42(3), 278-283.

Gottlieb, L. S., & Husen, L. A. (1982). Lung cancer among Navajo uranium miners. Chest, 81(4), 449-452. http://dx.doi.org/10.1378/chest.81.4.449

Graetz, G. (2014). Uranium mining and First Peoples: the nuclear renaissance confronts historical legacies. Journal of Cleaner Production, 84, 339-347.

Graetz, G. (2015). Energy for whom? Uranium mining, Indigenous people, and navigating risk and rights in Australia. Energy Research & Social Science, 8, 113-126. http://dx.doi.org/10.1016/j.erss.2015.05.006

Green, J. (2021). Radioactive Waste and Australia's Aboriginal People. In Nuclear Theory Degree Zero: Essays Against the Nuclear Android (pp. 32-49). Routledge.

Gutting, A., Högselius, P., Meyer, T., & Mbah, M. (2024). Geographies of Nuclear Energy. An Introduction. Historical Social Research/Historische Sozialforschung, 49(1), 7-31.

Haalboom, B. (2014). Confronting risk: A case study of Aboriginal peoples' participation in environmental governance of uranium mining, Saskatchewan. The Canadian Geographer/Le Géographe canadien, 58(3), 276-290.

Haalboom, B. (2016). Pursuing openings and navigating closures for aboriginal knowledges in environmental governance of uranium mining, Saskatchewan, Canada. The Extractive Industries and Society, 3(4), 1010-1017.

Hall, M. (2018). The whiteness of the bomb: Nuclear weaponry, race and the nation in Australian Indigenous poetics. Journal of Language, Literature and Culture, 65(3), 152-168.

Hart, B. T., Taylor, M., Iles, M., Kyle, G., & Sinclair, G. (2015). Resolving long-term issues related to surface water management and monitoring associated with the Ranger Uranium Mine, Northern Territory, Australia. Australasian Journal of Environmental Management, 22(4), 417-431.

Heber, R. W. (2005). Indigenous knowledge, resources use, and the Dene of Northern Saskatchewan. Canadian Journal of Development Studies/Revue canadienne d'études du développement, 26(2), 247-256.

Hecht, G. (2010). The power of nuclear things. Technology and Culture, 51(1), 1-30.

Hecht, G. (2012). Being nuclear. Africans and the global uranium trade. Cambridge: Mass.

Hill, C. R., & Ashipala, S. N. (2024). Follow the Yellowcake Road. Historical Social Research/Historische Sozialforschung, 49(1), 32-54.

Höffken, J., & Ramana, M. V. (2024). Nuclear power and environmental injustice. Wiley Interdisciplinary Reviews: Energy and Environment, 13(1), e498.

Hund, L., Bedrick, E. J., Miller, C., Huerta, G., Nez, T., Ramone, S., ... & Lewis, J. (2015). A Bayesian framework for estimating disease risk due to exposure to uranium mine and mill waste on the Navajo Nation. Journal of the Royal Statistical Society Series A: Statistics in Society, 178(4), 1069-1091.

Hussein, E. M. (2020). Emerging small modular nuclear power reactors: A critical review. Physics Open, 5, 100038.

IAEA. “Amid Global Crises, Nuclear Power Provides Energy Security with Increased Electricity Generation in 2021” (2022). https://www.iaea.org/newscenter/news/amid-global-crises-nuclear-power-provides-energy-security-with-increased-electricity-generation-in-2021

IAEA (2023) Global Inventories of Secondary Uranium Supplies, IAEA-TECDOC-2030, IAEA

Iles, M. (2005). Uranium-series radionuclides in native fruits and vegetables of northern Australia. Journal of Radioanalytical and Nuclear Chemistry, 264(2), 407-412.

Ingram, J. C., Jones, L., Credo, J., & Rock, T. (2020). Uranium and arsenic unregulated water issues on Navajo lands. Journal of Vacuum Science & Technology A, 38(3).

IPCC (2023). “Climate Change 2023: Synthesis Report”, Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva (2023).

Ishiyama, N. (2003). Environmental justice and American Indian tribal sovereignty: Case study of a land–use conflict in Skull Valley, Utah. Antipode, 35(1), 119-139.

Jackson, S., Poelzer, G., Poelzer, G., & Noble, B. (2023). Mining and sustainability in the circumpolar North: the role of government in advancing corporate social responsibility. Environmental Management, 72(1), 37-52.

Jones, B. A. (2017). The social costs of uranium mining in the US Colorado Plateau cohort, 1960–2005. International journal of public health, 62, 471-478.

Keeling, A. (2010). ‘Born in an atomic test tube’: landscapes of cyclonic development at Uranium City, Saskatchewan. The Canadian Geographer/Le Géographe canadien, 54(2), 228-252.

LaDuke W. (1999) All our relations: Native struggles for land and life. South End Press; 1999.

Lea, T., Howey, K., & O'Brien, J. (2018). Waging paperfare: subverting the damage of extractive capitalism in Kakadu. Oceania, 88(3), 305-319.

Liu, L., Guo, H., Dai, L., Liu, M., Xiao, Y., Cong, T., & Gu, H. (2023). The role of nuclear energy in the carbon neutrality goal. Progress in Nuclear Energy, 162, 104772. https://doi.org/10.1016/j.pnucene.2023.104772

Mamontova, N. (2023). The Nuclear Anthropocene of the Soviet north: Cold War vernacular collecting and mining uranium, and its legacies. Journal of Historical Geography, 82, 38-48.

Mapel, D. W., Coultas, D. B., James, D. S., Hunt, W. C., Stidley, C. A., & Gilliland, F. D. (1997). Ethnic differences in the prevalence of nonmalignant respiratory disease among uranium miners. American journal of public health, 87(5), 833-838. http://dx.doi.org/10.2105/AJPH.87.5.833

Marsh, J. K., & Green, J. (2020). First nations rights and colonising practices by the nuclear industry: An Australian battleground for environmental justice. The Extractive Industries and Society, 7(3), 870-881.

May, T. J. (2022). Kinship and Community in Climate-Change Theatre: Ecodramaturgy in Practice. Journal of Contemporary Drama in English, 10(1), 164-182.

Meyer, T., & Sérandour, A. (2024). Placing the intangible: Space, nuclear power and social sciences. Energy Research & Social Science, 115, 103611.

Mueller, J. M., Lima, R. E., & Springer, A. E. (2017). Can environmental attributes influence protected area designation? A case study valuing preferences for springs in Grand Canyon National Park. Land Use Policy, 63, 196-205.

Mulloy, K. B., James, D. S., Mohs, K., & Kornfeld, M. (2001). Lung cancer in a nonsmoking underground uranium miner. Environmental Health Perspectives, 109(3), 305-309.

Nelkin, D. (1981). Native Americans and nuclear power. Science, Technology, & Human Values, 6(2), 2-13.

Moody, R. (1979). Native peoples oppose uranium mining. Nature, 282(5741), 771.

Runyan, A. S. (2018). Disposable waste, lands and bodies under Canada's gendered nuclear colonialism. International Feminist Journal of Politics, 20(1), 24-38.

Runyan, A. S. (2022). Indigenous women's resistances at the start and end of the nuclear fuel chain. International Affairs, 98(4), 1149-1167. https://doi.org/10.1093/ia/iiac123

Samuel-Nakamura, C., Hodge, F. S., Sokolow, S., Ali, A. M. S., & Robbins, W. A. (2019). Metal (loid) s in Cucurbita pepo in a uranium mining impacted area in Northwestern New Mexico, USA. International journal of environmental research and public health, 16(14), 2569.

Samuel-Nakamura, C., & Ali, A. M. S. (2022). Metal (loid) s in Common Medicinal Plants in a Uranium Mining-Impacted Area in Northwestern New Mexico, USA. Plants, 11(15), 2069.

Sarkar, A. (2019). Environmental impact assessment of uranium mining on indigenous land in Labrador (Canada): biases and manipulations. Environmental Justice, 12(2), 61-68.

Sass, R. (1994). Labor Policy and Social Democracy: The Case of Saskatchewan, 1971–1982. International Journal of Health Services, 24(4), 763-791. http://dx.doi.org/10.2190/GB02-EWUK-0TFK-ELFL

Shrader-Frechette, K. (1996). Environmental justice and Native Americans: The Mescalero Apache and monitored retrievable storage. Nat. Resources J., 36, 943.

Shields, L. M., Wiese, W. H., Skipper, B. J., Charley, B., & Banally, L. (1992). Navajo birth outcomes in the Shiprock uranium mining area. Health Physics, 63(5), 542-551. http://dx.doi.org/10.1097/00004032-199211000-00005

Stanley, A. (2008). Citizenship and the production of landscape and knowledge in contemporary Canadian nuclear fuel waste management. The Canadian Geographer/Le Géographe Canadien, 52(1), 64-82.

Stephenson, B. (1978). EIS for uranium mining operation on Indian lands ruled adequate.

Stoffle, R. W., & Arnold, R. (2003). Confronting the angry rock: American Indians' situated risks from radioactivity. ethnos, 68(2), 230-248.

Strand, P., Howard, B. J., Aarkrog, A., Balonov, M., Tsaturov, Y., Bewers, J. M., ... & Rissanen, K. (2002). Radioactive contamination in the Arctic—sources, dose assessment and potential risks. Journal of Environmental Radioactivity, 60(1-2), 5-21.

Tillman, F. D., Anderson, J. R., Unema, J. A., & Chapin, T. P. (2020). Assessing uranium and select trace elements associated with breccia pipe uranium deposits in the Colorado River and main tributaries in Grand Canyon, USA. Plos one, 15(11), e0241502.

Tillman, F. D., Beisner, K. R., Anderson, J. R., & Unema, J. A. (2021). An assessment of uranium in groundwater in the Grand Canyon region. Scientific reports, 11(1), 22157.

UNFCCC, 2024. United Nations Convention on Climate Change. Disponível em: https://unfccc.int/.

Van Dam, R. A., Humphrey, C. L., & Martin, P. (2002). Mining in the Alligator Rivers Region, northern Australia: Assessing potential and actual effects on ecosystem and human health. Toxicology, 181, 505-515.

Vestergaard, C. (2015). Governing uranium globally (No. 2015: 09). DIIS Report.

Waggitt, P. W. (2004). Uranium mine rehabilitation: the story of the South Alligator Valley intervention. Journal of Environmental Radioactivity, 76(1-2), 51-66.

Weldon-Yochim, Z. (2023). Mining Matter/s: Bonnie Devine, Anishinaabe Cosmologies, and Uranium Extraction on the Canadian Shield. Third Text, 37(1), 24-43.

Yang, X., Cai, B., & Xue, Y. (2022). Review on optimization of nuclear power development: A cyber-physical-social system in energy perspective. Journal of Modern Power Systems and Clean Energy, 10(3), 547-561. https://doi.org/10.35833/MPCE.2021.000272