

SOCIETAL BARRIERS TO URANIUM MINING: A STUDY CASE FROM BRAZIL

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1. INTRODUCTION

Attitudes of different communities against uranium mining can impose severe constraints in uranium mining operations, potentially leading to insuperable barriers to project implementation and development. Some studies have investigated public opinion on uranium mining in different countries. One of these studies in Australia revealed that in 2008 just under half of the public supported the mining of uranium, while 36% opposed it [1]. The study also informed that over the previous decades, public support for nuclear energy in Australia had declined, while support for uranium mining had remained relatively stable. In Canada, a study prepared by AREVA Resources [2] indicated that

“the uranium mining and uranium mining companies continue to hold a place of importance in the minds of Saskatchewan residents. Support remains high among survey respondents, both province-wide and in the North... as the result of the perception... that the primary companies operating in the industry operate safely and responsibly, and contribute positively to the province”.

A study developed by the University of Eastern Finland, Litmanen and others [3] indicated that public opinion was more critical of uranium mining operations in comparison to other types of mining activity such as (other) metals and industrial minerals. Only 1–4% of the interviewed individuals considered these activities as being unacceptable, while in the case of uranium mining this level was determined to be between 38 and 51%. Six variables were examined in the study: environmental attitudes, perceptions of the disadvantages and benefits, knowledge of the mining, trust, trust in officialdom and acceptability of foreign mining companies. Familiarity with operations correlated strongly with the acceptance. Drawbacks have a stronger impact on acceptability than have the benefits. Trust in the authorities and legislation is strongly and positively correlated with acceptance. Finally, it was seen that the people who are more willing to accept foreign mining companies were also those more inclined to accept uranium mining.

Regarding Africa’s situation, the place of the continent in the global nuclear market was examined in 2012 [4]. This study considered that international and African tools either exist or are being set up to improve the governance of uranium mining in Africa. It concluded that improvement requires attention to strengthening government capacity and ensuring wider consultative processes.

2. PERSPECTIVES FROM THIS WORK

In the scope of this work, over one hundred entries on the internet that captured individual views on uranium mining from all over the world were examined. This strategy did not follow any strict scientifically based methodology. The intention was to achieve a preliminary assessment of the hypothesis that basic perception towards uranium mining was the same all over the world and, if so, what were the main aspects driving people’s views and positions. As a result of this investigation, it was found that attitudes were affected by four main issues: (i) misuse of scientific evidence that ends up propagating fear, (ii) influence of historical (legacy) sites, which in many cases were developed outside the proper regulatory framework, that are associated with practices that are no longer accepted or even seen as good practices, (iii) long term issues,

i.e. mining sites remain dangerous even after their closure, (iv) the perception that these operations bring considerable burden to indigenous people (this is because mining operations in many circumstances take place in remote areas). These points above seem to be fully consubstantiated by a wide diverse publications/reports available in the literature. Some examples are provided below.

The Quebec Mineral Exploration Association and the Quebec Mining Association wrote an open letter protesting the “attempts to manipulate public opinion against the mining industry and the uranium industry in particular” [5]. The manifesto refers to the announcement made by a group of doctors that would be leaving the area of a future mining operation. The open letter states that the group of doctors were claiming that the principles of precaution and prevention should be considered in any decision regarding the implementation of a new uranium mining project and led to a more extreme claim for a “moratorium on uranium mining and exploration in Quebec”. The letter signatories indicated that the overall manoeuvre against uranium mining was intended “to instil doubt and fear in the largest possible number of citizens of good faith, including doctors”.

A report on perceptions and realities in modern uranium mining was released by the OECD Nuclear Energy Agency in 2014 [6]. The publication concludes that public perception of uranium mining is largely based on the adverse health and environmental impacts resulting from past practices, i.e. those that took place during an essentially unregulated early phase of the industry.

Brugge and Goble (2002) [7] claimed that the Federal Government in the USA “deliberately avoided dealing with a health disaster among Navajo uranium miners”. The authors claimed that even after two decades after the harmful effects of uranium mining were known, the implementation of protective measures had not been undertaken.

No doubt that what makes uranium mining even more subject to public scrutiny than other mining activities or industrial operations is the radioactive properties of uranium and its progeny. In addition, one cannot ignore the obvious link of mining operations to atomic bombs (in the past) and nuclear power (nowadays). It is also a critical aspect that the legacy sites created with the operations that were initiated during the 1940s and 1950s up to the 1980s now need governmental funding to finance the remediation required to render the sites safe and stable. Funding to be allocated for the remediation of these sites will compete, especially in countries with less advantaged economies, with other demands, particularly those of a social nature (e.g. education and health) and this will not be well perceived by the public. An obvious reaction is that societies with this perception will stand against future operations based on the experience gained from past operations.

3. THE CONTEXT IN BRAZIL

In Brazil, the only ongoing uranium mining and processing operation started in 2000 and is located at Caetité (Lagoa Real province), a semi-arid region in the central south-west part of Bahia state [8]. The extraction of uranium from the ore is achieved by means of a heap leach process. Owing to scarcity of water, local populations rely, to a considerable extent, on the abstraction of groundwater for living purposes. Enhanced concentrations of uranium in these waters become an issue for the local population as it is not seen as being due to natural processes but rather as a result of the uranium mining operations.

In April 2008, a team from Greenpeace collected eight samples of groundwater (allegedly used for human consumption) in an area with a radius of 20 km of the uranium facility. It has been reported that two of these samples presented uranium concentrations “far above” the guideline proposed by the World Health Organization [9].

The report refers to some publications that are intended to support the hypothesis that undesirable health effects allegedly caused by the uranium operations in the region are being observed. The Greenpeace report,

in page 17, states that in one of the studies the uranium incorporation rates by inhabitants of Caetité were 25 times higher than those presented in a control region. The referenced study in the report was indeed an M.Sc. dissertation that was subsequently published in a peer review journal [10]. In the journal, the information is presented in a different way i.e. “uranium concentrations in teeth from residents of Caetité are about 8 times higher than those from the control region”. A discrepancy is present between the information contained in the report (uranium incorporation rates 25 higher than that presented in the control area) and the one in the article (incorporation 8 times higher) is observed. The article [10] also reveals that from a total of 41 tooth samples collected in Bahia state, 17 came from the city of Caetité and only 2 from the city of Lagoa Real area where the mine is located. The results are not depicted in tables, but rather in graphics. It can be seen that the two samples came from an individual of around 17 and another one of 31 years old. While the first sample presented uranium concentration of something around 5 ng/g the other one showed a value 10 times higher. On the basis of these results, the authors infer that higher values could correspond to overexposure cases potentially due to food and water ingestion. As a conclusion and based on the dataset mentioned above, the article suggests that “uranium body levels in residents of Caetité are also much higher than the worldwide average and because of that daily ingestion of uranium in Caetité, from food and water, is equally high”. Finally, it is proposed that “the populations of the studied localities, and Caetité, are subject to radiobiological risks much higher than those for populations living in other regions of Brazil or abroad”.

It is recognized that few data are available that adequately describe the dose–response toxicity of uranium after an oral exposure in humans but in the case of high levels of exposure, transient renal dysfunction would be expected. The point to be made here is that if any health effects would be expected due to chronic ingestion of uranium these would have been kidney disfunctions instead of radiation induced effects. Along the same lines, a great deal of fear is caused by the potential effects of radon gas associated with the mining operations. In this regard, an oncologist suggested that the number of lung cancers in Caetité was twice the average for the state of Bahia and three times higher than the number observed in the south-west region of the state. It is also suggested that the increased number of lung cancers is due to the radon concentration in the air that is said to be “10 times higher than the value recommended by the World Health Organisation”. Association between neoplasm increase and mining operations in Caetité is also proposed by another study [11], particularly thyroid cancer and leukaemia. Reference levels for radon in dwellings set out in the IAEA International Safety Standards is of the order of 300 Bq/m³ [12]. Radon concentrations in open air of a uranium mining area is reported to vary in the range of 1.75–25.6 Bq/m³ [13].

The Canadian Nuclear Safety Commission states in its home page addressing the question “Do uranium mines and mills increase radon levels in the environment?” states that studies have shown that uranium mining and milling activities do not increase radon levels above background levels in the environment away from the mine site [14]. In addition, it is said that “Radon exposure to members of the public from CNSC-regulated activities is virtually zero”. With these pieces of information in mind and considering that: (i) the main health effects of uranium are not related to its radiological properties, (ii) the main health effect of radon is lung cancer, not leukaemia or thyroid cancer and (iii) with the typical environmental concentrations of radon, even in areas close to uranium mining, no increase in adverse health effects would be expected.

It can be stated that all the issues raised so far in NGOs’ reports, blogs, social media and other sites in the internet are not consistent and constitute perfect examples of how (pseudo/inconsistent) scientific information can be used to propagate fear, as indicated above. They cause huge negative psychological impact in the populations that are exposed to these pieces of information.

4. IAEA-RELATED ACTIVITIES IN CAETITE

In 2010, the IAEA organized a mission of the Uranium Production Site Appraisal Team (UPSAT) to review the uranium production site of Caetité [15]². It was found that the operations at Caetité were run with no evidence of adverse environmental impact outside the mining licence area. The UPSAT team also noted that within the mining production area, some environmental impacts in groundwater were noted and these should be further studied.

Between 2012 and 2015, the IAEA supported Brazil, under the IAEA's Technical Cooperation Programme, in implementing a project entitled Sustainable Water Resources Management in a Uranium Production Site (BRA 7010). This project was intended to contribute to the formulation of proposals that could lead to the sustainable management of water resources in operations in Caetité, with due consideration of the environmental aspects of water management, in addition to social issues. The main counterpart of the project was the Institute of Radiation Protection and Dosimetry (IRD) from the Brazilian Nuclear Energy Commission (CNEN).

Taking into consideration the many concerns of the population in relation to the contamination of the environment, an expert mission³ to Brazil to advise the project team on the best approaches to be used in the communication of the project results to the relevant audiences was implemented under the auspices of the BRA 7010 project. To support a wider understanding of the overall perception in relation to mining operations, a wide-ranging survey was conducted that included analysis of information provided in local blogs, electronic newspapers and materials and texts available on NGO sites, as well as recorded interviews with residents available on YouTube. The acquisition of information by means of the above survey did not follow any rigorous science based method of information acquisition and should be considered of a qualitative nature.

5. DISCUSSION AND CONCLUSION

The survey confirmed that the dissemination of inaccurate information is very intensive. While public opinion (local community) is built on information of questionable scientific consistency, the results provided by more robust technical/scientific work is not made available⁴ to local stakeholders and/or is simply disregarded by those interested in promoting unjustified fear. This approach was accompanied by an expressed and considerable lack of transparency as regards mining operations.

Opinions formed on the basis of what is perceived to be reliable scientific investigations which appear to indicate that cases of cancer in the region have risen after the operations of the mining company began. The study on the concentration of uranium in teeth of the population of Caetité mentioned above [10] has been widely used to sustain the idea that people are being exposed to uranium isotopes. It is also suggested that some of the observed cancer cases are related to high radon concentrations in air. It has also been observed that complaints about the mining and milling operations go beyond the radiological impacts. On the social dimension, it is argued, among other things, that the company did not employ a significant number of workers from the region. It was also indicated that selling the agricultural products cultivated in the region became rather difficult because of a belief that these products are contaminated with radioactive elements. In addition to the radiological impacts, complaints about the dust coming from mining operations (resulting from blasting) do also occur. There are also complaints on the scarcity of water springs that, apparently in the past, would allow the irrigation of soil in which different agricultural products were cultivated. Finally, the collected information indicates that complaints also extend to the nuclear regulatory body. The notion

² The complete report was not released.

³ Three experts from Finland, Slovenia and the United Kingdom participated in the mission.

of a lack of transparency, a lack of information and, ultimately, a lack of independency is present. This attitude, however, seems not to apply to other regulatory bodies (e.g. the environmental regulator).

As a conclusion, the perception that the official organizations and local authorities are not ‘protecting’ the local population gives room for NGOs from outside the region to fill this ‘vacuum’. By adopting an anti-nuclear discourse and emphasizing the risks related to the mining operations, these organizations align themselves with the population. They gain the trust of residents and, by providing concerted information suggesting the inappropriateness of the operations, lead the population to take a stand against the development of mining operations in the region. In this regard, it can be clearly seen that the arguments put forward by the NGOs in the different channels of communication are reproduced by members of the community in their interviews.

The analysis of this situation suggests that there is not a consistent communication/engagement plan by the mining company or regulator. As happens on many occasions, operators tend to be reactive and not proactive. That means, by not having in place a continued mechanism of interaction with the population, room is left for the action of groups and individuals that clearly demonstrate an attitude against nuclear energy and related activities. Some of the statements made go far beyond the issues that directly affect the local population and bring to local discussions an agenda that is far broader and one which belongs to an international conversation.

6. THE PATH FORWARD

Owing to the many concerns expressed by the population of Caetité about environmental contamination (more specifically contamination of groundwater), it is of utmost importance that all information acquired with the IAEA supported Technical Cooperation Project is communicated to the relevant stakeholders. The expert mission to Caetité served as the first step in a process to help improve a situation that is currently hindered not only by a lack of trust between the actors but also because of a lack of proper understanding of the potential environmental impacts associated with uranium mining and the operations in Caetité. The expert mission was complemented with additional work investigating information available on different web sites on the internet as noted before. With these considerations in mind, it was proposed that in any similar situation, a set of actions could be considered, which are discussed below.

A more proactive attitude should be in place in terms of communication with the different stakeholders, not only with the different regulatory bodies and other relevant organizations, but also, and perhaps mainly, with the local communities. It must be recognized that the lack of engagement allows other organizations to continue filling the existing gap and aligning themselves with these communities. Therefore, the NGOs will be perceived as those who really care about the local community’s lives and well-being. Under these circumstances, it is not a surprise, as this study revealed, that members of the local communities will adopt the discourse and ideas presented to them by these organizations. In this regard, meeting with people from local communities, especially those living in areas where water samples were collected, can be useful. The meetings could then start with information on the mining project (why? how? what?). Subsequently, explanations on natural radiation should be provided, making comparisons with exposures to radiation in our daily lives. Scientific project results should then be presented. In support to these meetings, press releases should be prepared. These should be short, with easily understandable information and photos. An important issue to be considered will be how to involve NGOs in these meetings. They should also be participating in the discussions and their arguments should be carefully listened to and discussed, but not in a confrontational way.

It must be ensured that that the aims and ethics of science are clearly understood and that the consequences, lessons learned and future steps in the BRA 7010 project are explained. With respect to this point, a specific part of the IRD web site should be devoted to the project and an online information channel should be

opened with as many relevant summaries and scientific abstracts as possible, but written in language comprehensible to the layperson. Scientific articles on the project results should be prepared and published.

Beyond the project scope, educational material on environmental and natural background radiation for different levels of students and children and for community groups could be developed.

A last point to be carefully considered refers to the expectations of the local communities on the social role to be played by a mine operator. Taking into consideration that such communities might need basic assistance (to be provided by the State), a natural expectation is that some of the needed actions could be provided by the mine operator. It is not expected that a company will replace the role of the State in addressing the basic needs of a population. However, within the scope of so-called ‘corporate social responsibility’, it might be the case that the mining company can address, to a certain extent, some of these needs. In this regard, the notion of social responsibility goes beyond the concept of “justifying the company existence and documenting its performance through the disclosure of social and environmental information” [16]. Social aspects impacting on uranium mining operations are also discussed in Ref. [17]. The author states that “some projects start poorly on environmental and social aspects; they must then fight to gain trust and counteract adverse aspects of their environmental and social impacts, real and perceived”. This statement reflects quite well the situation of the uranium mining operations in Brazil.

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REFERENCES

- [1] McALLISTER, I., Public Opinion Towards the Environment Results from the ANU Poll Rep. 3, The Australian National University (2008), http://politicsir.cass.anu.edu.au/sites/default/files/docs/2008-29_ANUpoll_environment_report_0_1.pdf
- [2] AREVA RESOURCES, Public Support for the Uranium Mining Industry in Saskatchewan (2017), http://mining.areva.com/canada/liblocal/docs/Information/Publications/More-Publications/2017_Public_Opinion_Survey_Situation_Summary_web.pdf
- [3] LITMANEN, T., JARTTI, T., RANTALA, E., “Citizens’ attitudes toward mining in Finland”, paper presented at the Finnish–Russian Sustainable Mining Res. Sem., Joensuu, 2016, <http://www.uef.fi/documents/547540/0/Citizens%E2%80%99attitudes+toward+mining+in+Finland+10.2.2016+UEF.pdf/1777f53e-a079-4056-97a8-d87f77dbcd55>
- [4] DASNOIS, N., Uranium Mining in Africa: A Continent at the Centre of a Global Nuclear Renaissance, South African Institute of International Affairs Occasional Paper No. 122, SAIIA, Johannesburg (2012).
- [5] MARKET WIRED, Uranium and the manipulation of public opinion (2010), http://www.marketwired.com/printer_friendly?id=1134761
- [6] OECD NUCLEAR ENERGY AGENCY, Perceptions and Realities in Modern Uranium Mining, extended summary, NEA Rep. No. 7063, OECD, Paris (2014).
- [7] BRUGGE, D., GOBLE, R., The history of uranium mining and the Navajo people, Am. J. Pub. Health 92 9 (2002) 1410–1419.
- [8] FERNANDES, H.M., GOMIERO, L.A., PERES V., FRANKLIN, M.R., SIMOES FILHO, F.L., Critical analysis of the waste management performance of two production units in Brazil — part II: Caetite production center, J. Environ. Manage. 88 4 (2007) 914 – 925.
- [9] GREENPEACE, Ciclo do Perigo, Impactos da Produção de Combustível Nuclear No Brasil (2008), <https://www.greenpeace.org/brasil/Global/brasil/report/2008/10/ciclo-do-perigo.pdf>

- [10] PRADO, G., et al., Evaluation of uranium incorporation from contaminated areas using teeth as bioindicators — a case study, *Radiat. Prot. Dosim.* **130** 2 (2008) 249–252.
- [11] CRUZ, J.A., RIBEIRO, F.S., Association between the neoplasm increase and uranium exploration in the municipalities of Caetité and Lagoa Real, Bahia, Brazil, *Europ. J. Canc.* **60** 1 (2016).
- [12] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).
- [13] RAGHAVENDRA, T., RAMAKRISHNA, S.U.B., VIJAYALAKSHMI, T., HIMABINDU, V., ARUNACHALAM, J., Assessment of radon concentration and external gamma radiation level in the environs of the proposed uranium mine at Peddagattu and Seripally regions, Andhra Pradesh, India, *J. Radiat. Res. Appl. Sci.* **7** 3 (2014) 269–273.
- [14] [CANADIAN NUCLEAR SAFETY COMMISSION](http://nuclearsafety.gc.ca/eng/resources/fact-sheets/radon-fact-sheet.cfm#levels), Radon in Canada’s Uranium Industry (2012), <http://nuclearsafety.gc.ca/eng/resources/fact-sheets/radon-fact-sheet.cfm#levels>
- [15] WAGGITT, P. “First UPSAT mission takes place in Brazil”, IAEA Fuel Cycle and Waste Newsletter **6** 1 (2010) 1–2, https://www.iaea.org/OurWork/ST/NE/NEFW/Technical-Areas/NFC/documents/uranium/Waggitt_2010_UPSAT_Brazil.pdf
- [16] JENKINS, H., YAKOVLEVA, N., Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure, *J. Cleaner Product.* **14** 3–4 (2006) 271–284.
- [17] WOODS, P.H., “Environmental and social aspects of feasibility studies, mining operations and closure: Balancing realities and expectations from different angles”, ALTA 2015 Uranium–REE (Proc. Int. Conf. Perth, 2015), ALTA Metallurgical Services, Melbourne (2015) 2–16.