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MERCURY AND THE POLLUTION OF THE RIVERS IN THE YANOMAMIS LANDS

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Abstract: Mercury pollution is a worldwide problem associated with mining activities, with profound effects on human health and the environment. Recent advances have demonstrated a causal relationship between exposure to mercury and several human pathologies. The Yanomami near the mine on the Uraricoera River are contaminated with mercury, a metal with bioaccumulative properties. The aim of this study was to review the literature on mercury and river pollution in Yanomami lands. The use of mercury for gold mining in indigenous lands in the Amazon is done clandestinely and has socio-environmental impacts. Traditional Amazonian peoples, including indigenous and riverine peoples, have been affected by deforestation and mercury pollution of rivers and fish. Use of mercury for gold mining on indigenous lands in the Amazon is confidential and causes socio-environmental impacts. The Yanomami are under attack and need to look into these issues.
Keywords: Mercury and pollution. Yanomami people. Pollution of rivers.

INTRODUCTION

Mercury pollution from exploration activities has been the subject of research in Brazil and worldwide. Mineral extraction activities can alter the environment and become a source of degradation if adequate control measures are not taken. (PAULA et al., 2018).

Mercury pollution is common in mining areas and affects large areas of Brazil. Miners use mercury to collect gold from concentrates in the form of amalgam and recover metallic gold through "burning", volatilizing mercury, which is carried away by the wind and then precipitated (SCARPELLI, 2003). Due to the lack of operational technical knowledge about the process, lack of culture to recycle mercury, combined with the relatively low cost of liquid metal, large amounts of mercury are released into the soil, water and air.

Gold mining produces tailings containing metallic mercury, in addition to problems such as mischaracterization of the original topographic forms, suppression of vegetation and silting up of rivers (TANNÚS, 2001). Improper land use can also increase mercury methylation levels. Erosion can transport mercury to local water bodies and contaminate groundwater (HIMENES et al., 2005). Factors such as pH, conductivity, oxygen availability, temperature, biological activity and nutrient concentration are associated with the organicization of mercury and other heavy metals in soil and water (PAULA et al., 2018).

Mining in the Amazon region, as a mining activity, necessarily means the transformation of the landscape and nature, in addition to a series of social problems. The social conflicts and environmental impacts of the invasion of indigenous lands are evident. Among them, deforestation, silting and pollution of rivers, wild animals and humans.

Artisanal mining is responsible for 37% of global anthropogenic mercury emissions (GIBB; O'LEARY, 2014). Information on the amount of mercury released into the Amazon environment is controversial, but it is estimated that the metal is used in a 1:1 ratio. Unofficial estimates estimate that in the 1980s, 1,000 to 2,000 tons of gold were produced, presumably using the same amount of mercury (RAMOS, 2020).

The highest concentrations of natural mercury in the world are found in Amazonian soils (WASSERMAN JC; HACON; WASSERMAN MA, 2003). Deforestation and mining erode soils, bringing mercury to aquatic environments, where it is methylated by microorganisms and enters trophic networks (GUIMARÉES et al., 2000).

Methylmercury accumulates in fish, which are the main vectors of organic mercury for humans (MAHAFFEY, 2004).

Recent studies (FIOCRUZ, 2016; VEGA et al., 2018) have confirmed worrying levels of contamination by mercury, a toxic metal with bioaccumulative properties, among indigenous peoples from communities close to the mining areas of the Uralikola River, especially in the form of methylmercury, causing serious and permanent damage to health (OLIVEIRO, 2014).

Despite the responsibility of the State and the recognized vulnerability of indigenous peoples, the Yanomami have been continuously exposed to mercury for at least three decades. Studies have documented high levels of pollution in Roraima communities, but little is known about direct clinical effects on the health and well-being of these populations. (VEGA, 2018)

The aim of this study was to review the literature regarding mercury and river pollution in Yanomami lands.

METHODOLOGY

The methodology used in this study is the bibliographic method, which refers to systematic research based on materials published in books, magazines, newspapers, electronic networks, that is, materials accessible to the public. After selecting a topic, defining a preliminary bibliographic survey and asking questions, a provisional project on the topic was prepared. The main objective of the exploratory phase is to analyze the problem, having as main form the bibliographical research.

Scientific research exists in all fields of science, and in education we find some published or ongoing. It is the investigative process of solving, answering or investigating questions in the study of phenomena. Bastos and Keller (1995, p. 53) define: "Scientific research is the systematic investigation of a subject, aimed at elucidating various aspects of the study".

For Gil (2002, p. 17) "Research is necessary when there is not enough information to answer the question, or when the available information is too confusing to be adequately relevant to the question".

Scientific research is presented in different ways, one of them is the bibliographical research that will be discussed in this article, revealing all the steps that must be followed to achieve it. This type of research was conceived by several authors, including Marconi and Lakatos (2003) and Gil (2002).

Bibliographical research is inserted primarily in an academic environment and aims to improve and update knowledge through the scientific investigation of published works.

This hypothetical strategy is the starting point for a research project and, as the reading progresses and the consequent maturation of the understanding and research requirements, clear contours will emerge from the absorbed changes.

In addition to current reading books, research will be carried out in resources that emphasize other sources of interest for bibliographic research: references, articles and theses, scientific journals and indexing of journals and abstracts. These resources will be used for research and included in the bibliography.

Reading parts of the bibliographic material will have the objective of verifying works of interest. From that moment on, we will make an analytical reading of the selected text, identify the key ideas, categorize and synthesize them.

For Prodanov and Freitas (2013, p. 24), the method is considered a method for an end. In the past, many thinkers defended that there is only one way to meet all fields

of knowledge. They advocate "a one-size-fits-all approach". However, scientists and philosophers of science advocate many other approaches. These methods should be used according to what is being studied and the type of proposition. For Lakatos and Marconi (2003, p. 84), however, it is the modern concept of method that matters. To this end, the author "thinks, like Bunge, that the scientific method is the theory of investigation".

For Prodanov and Freitas (2013, p.24), if a method "is a procedure or a way of achieving an end, and the end of science is the pursuit of knowledge", it can be said that the scientific method "is a program set". According to Trujillo Ferrari (apud Prodanov and Freitas, 1974), the scientific method is "a characteristic of science that constitutes a fundamental tool that initially commands the mind in a system and traces the scientist's program along the way". Until it is scientifically objective.

THEORETICAL REFERENCE

The mining industry in Brazil has a tradition of representing the basis of an important sector of the national economy (VASSEN, 2017). Mining is one of the oldest productive activities carried out by humanity, moving the economy of many nations for centuries. However, since the emergence of capitalism, the mining activity has also provoked an intense debate about its ability to promote economic and social development in the face of its externalities, depletion of ore (non-renewable resources), primarization versus industrialization, tendency towards the formation of an economy of enclaves and negative socioeconomic impacts (ROCHA, 2020).

According to Silva, 2014, the main environmental impacts of mining activities are: land use and occupation disputes, deforestation, removal of fertile soil, water pollution, air pollution, noise, vibration, visual impact and landscape degradation. In addition to these effects, changes in topography and soil movement, slope instability and increased erosion and silting processes may also occur (CABRAL et al., 2012), which may be important issues for municipalities to address in order to avoid risks. geological.

According to Pontes et al., 2012, the impacts of mining activities are linked to competition for land use and occupation, generating socio-environmental conflicts that sometimes result from the lack of public policies that recognize the diversity of interests involved.

As one of humanity's oldest productive activities, mining has driven the economic development of many countries for centuries. Since the advent of capitalism, mining activities have faced their externalities, ore depletion (non-renewable resources), primary and industrialization, formation of an enclave economy and negative socioeconomic impacts (MESQUITA, 2016).

According to Fernandes (2014), the various stages of exploration of a mineral property, from mining, transport, ore processing, to mine closure or cessation of activity, have negative impacts on extraction.

Mercury is a neurotoxic chemical agent (LARINI, 1997) that disturbs the organic balance and crosses the blood-brain and blood-placental barriers in humans, causing severe changes in body homeostasis. Due to its additive properties to gold, it is used in the process of extracting gold from other ores, followed by "by heating in tanks, the mercury evaporates in the open air, being characterized by aggression to the environment and to the health of prospectors" (SOUZA ; LINS, 1989, p. 9) because mercury liquefies and evaporates at low temperatures.

In addition to polluting the soil, mercury can indirectly cause serious health

complications for miners or others. According to research, methylmercury accumulates in the food chain and becomes established in nature. Even when thrown over the beds of streams and rivers, the material can fall into the watercourse due to rain. In humans, it is known to cause severe neurological disorders, as happened during the intense gold rush in Serra Pelada, Pará, in the 1980s. Garimpeiros who inhaled mercury suffered serious health complications and even died. (FOLHAWEB, 2019). Yanomami Davi Kopenawa claims that illegal mining on indigenous lands is the main cause of pollution (ROCHA, 2016).

In recent years, indigenous peoples have faced a series of challenges within their own territories, mainly due to the continuous invasion by illegal mining activities, through the development of illegal mining, predatory agriculture and illegal logging, the main factors of risk and resettlement of indigenous peoples, areas of vulnerability: culture, biome, physical and mental health.

The Yanomami indigenous lands, approved by decree in 1992 (BRASIL, 1992), are located in the extreme north of Brazil, west of the state of Roraima and north of the state of Amazonas, within the legal Amazon. In 2018, a Yanomami shaman stated that five thousand miners were engaged in mining (FOLHA WEB, 2018), a fact confirmed in an official document from the National Foundation of India (FUNAI), published in December 2016, pointing to the presence of the same five thousand miners (FUNDAÇÃO NACIONAL DO ÍNDIO, 2016), and a case study pointing to the performance of the Brazilian army in the capture of eight hundred miners in a gold mine (RAMOS; RODRIGUES, 2018), mosaic About more than 9 million hectares of indigenous lands. Garimpeiros are "all workers involved in the extraction of mineral substances" (RODRIGUES, 2017, p. 29).

Approved in 1992, the Yanomami Indigenous Land is located in the states of Roraima and Amazonas, extending to the border with Venezuela, with an area of 9,419,108 hectares, similar in size to Portugal, and an estimated 26,780 indigenous peoples (SESAI, 2019) from 8 different races, including 6 isolated ethnic groups. In Venezuela, the Yanomami live in the Alto Orinoco-Casiquiare Biosphere Reserve, covering 8.2 million hectares. Together, these areas form the largest indigenous forest territory in the world. On the Brazilian side, Indigenous Lands (TI) continue to appear in Imazon4 advertisements as one of the most stressed ILs in the Amazon.

The Yanomami remained isolated from the rest of the world until the 1940s, when they maintained permanent contact with society. This began to change dramatically in the 1970s when non-Indians began illegally mining in the area. Thus, the conflict continued to intensify until 1992, when the Yanomami indigenous land was granted, covering both the Yanomami and the Yequana, but this did not mean the end of illegal activity (FERNANDES, 2021).

Throughout history, we can see that the Yanomami indigenous land is a territory burned by illegal mining and coveted by legal mining. With regard to legal mining, the area was the subject of 464 active studies and mining requests where applicants only expected to have rights over the mining process and in fact any mining activity in these areas was considered an environmental crime and appropriation of public goods , in addition to five titles of active authority, which include research grants and availability, where mining or research is already possible in the desired area (FERNANDES, 2021).

The Yanomami are an agricultural and hunter-gatherer people of the northern Amazon rainforest who inhabit the confluence

of the tributaries of the Amazon/Rio Negro (Brazil) and Orinoco (Venezuela) basins. There are several historical contact surfaces, but a large portion of the population can be described as recent contact (NILSSON, 2017).

The Yanomami have been depopulated by disease in the past. There is considerable debate about population regulation in the Yanomami at acceptable levels to maintain a balance that presupposes limiting the amount of protein needed for population sustenance and growth. Protein restriction means the population needs to be kept at a low population density(NILSSON,2017).

Gold was and is the main ore that attracts illegal prospectors (DE THEIJE, 2020), transforming this land and other Aboriginal lands in the Northern Arc of the Borderlands into a new frontier for mineral exploration. The high number of applications can be explained by the expectation of "saving a place", as candidates apply with the aim of deregulating mining in the future on Aboriginal lands. The current president of the republic, Jair Bolsonaro, has repeatedly made speeches against environmentalist and indigenous initiatives, clearly in favor of exploration and mining (WANDERLEY et al., 2020), which has encouraged the interests of legal and illegal mining, as reported by various indigenous and environmental organizations, as well as news outlets and organizations (GONZALEZ, 2020).

Illegal mining poses a significant threat to people living in Yanomami indigenous lands. In addition to destroying the ecosystem, the Yanomami not only have a spiritual connection with the ecosystem, but also maintain the material conditions of its existence. Illegal gold mining is the main cause of mercury pollution in the Uraricoera and Mucajaí rivers, the longest in Roraima. As a result, fish in the river ecosystem are also contaminated with mercury, as are the Yanomami and Ye'kuana who feed on these animals (LIMA, 2016).

Prospectors used mercury to concentrate gold in pots, proving the need for a well-studied process and decontamination of areas contaminated by the metal. Several methods have been developed to remove mercury from industrial wastewater and residues from amalgamation processes. In general, the treatment involves physical-chemical techniques such as separation by decantation, chemical precipitation, coagulation, absorption, ion exchange and solvent extraction, electro-oxidation and flotation. Biological methods are also being evaluated for hydrometallurgical processing, bioleaching of concentrates and monitoring, removal and recovery of metals in liquid effluents by bioabsorption (HIMENES et al., 2005).

Mercury toxicity stems from its ability to interfere with enzymatic metabolic reactions. The effects of mercury on the body are manifested in the form of acute illnesses, which, when inhaled in large quantities, can cause damage to the lungs, kidneys and central nervous system, leading to death. (PAULA et al., 2018).

CONCLUSION

Given the severity of mercury poisoning and the fact of being simultaneously exposed to other risk factors in the environment, it should be considered that populations exposed to mercury in mines and industrial scale mining need help and can volunteer for in-depth scientific research .

Traditional Amazonian peoples, including indigenous and riverine peoples, have been affected by deforestation and mercury pollution of rivers and fish. Use of mercury for gold mining on indigenous lands in the Amazon is confidential and causes socio-environmental impacts. The Yanomami are under attack and need to look into these issues.

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