

International
Journal of
**Biological
and Natural
Sciences**

**THE POLLUTION OF THE
GUANABARA BAY IN
THE CONTEXT OF FOOD
SECURITY**

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Abstract: The environmental pollution of Guanabara Bay, characterized by the deforestation of the surrounding area, dumping of sewage and industrial waste, has been causing damage to the environment over the years. The production of fish and bivalve molluscs (oysters and mussels) has been negatively affected by pollution, either by reducing the amount of fauna or its microbiological quality, making them unsafe foods from a public health point of view. In addition to food poisoning, there is a risk of intoxication by chemical pollutants (pesticides and heavy metals), substances with high carcinogenic power. All these damages are, to a greater or lesser degree, caused by anthropogenic actions and one of the ways to minimize the damage caused by environmental pollution includes the adoption of public policies for preservation, environmental conservation and the adoption of adequate technical procedures that help in maintaining safety. food to promote health.

Keywords: Guanabara's Bay; Food Safety, Pollutants and Public Health.

INTRODUCTION

Environmental pollution in Guanabara Bay is an old problem in the city of Rio de Janeiro that causes inconvenience to tourism, harming the beauty and bathing conditions of Rio's beaches. The poor microbiological quality of the water in the Guanabara Bay, as a result of environmental pollution, caused mainly by the dumping of sewage and industrial waste, has a negative impact on public health and the environment, whether in terms of biodiversity or making fish into crustaceans. and molluscs suspected of contamination. This way, food security grows in importance on a global scale, as a portion of the world population survives in precarious conditions, without access to quality food and exposed to serious risks, such as food poisoning caused by microorganisms

and exposure to heavy metals, many of them, with carcinogenic action.

In this article we will address the importance of Guanabara Bay for the environment, pointing out some problems that led to its environmental degradation. Next, we point out the main human actions responsible for its degradation and describe environmental pollution as a risk factor for the quality of foods of aquatic origin. In the end, we tried to reflect on the need to preserve the environment in order to guarantee food security and the living conditions of fishermen and riverside populations.

The present research intends to reflect, in a qualitative approach and of bibliographical revision, on the possible measures adopted by the public power together with the society, in search of minimizing the problems arising from the environmental pollution of the Guanabara Bay.

THE ENVIRONMENTAL IMPORTANCE OF GUANABARA BAY

Guanabara Bay is bathed by the Atlantic Ocean and located in Rio de Janeiro in the southeastern region of Brazil. Originally it was an immense river with estuarine waters that stretched from the Sugarloaf Mountain to the beach of Jurujuba, Niterói. Natural changes over 300,000 years led to the formation of the bay whose name in Tupi-Guarani means "sea bosom" (Lamego, 1964).

At the beginning of the last century, the aquatic ecosystem of the bay produced shoals of several species of fish, especially sardines, sea bass, mullet and xereletes, as well as crustaceans (lobsters and shrimp). It was common to observe the presence of marine animals such as cetaceans (dolphins and whales) swimming freely in these waters. On the other hand, despite the richness of the fauna and flora of this environment, it was observed that the Atlantic Forest was

destroyed on the slopes, due to deforestation caused by the indiscriminate extraction of pau-brasil and later by sugarcane plantations. These processes carried out by man caused the destruction of the native fauna and modified the conformation of the rivers that flowed into the Bay and were the main access routes to the interior (Amador, 1996; Carvalho, 1996).

Over the years, anthropogenic changes influenced by the modernization and urbanization of Rio de Janeiro contributed to the destruction of the bay's habitat. Population growth brought the need for the construction of housing properties, but this occurred in a disorderly way, creating unsatisfactory conditions of basic sanitation, which resulted in water contamination due to the dumping of garbage and waste by the population that inhabited the hills and slopes that surround the city (FEEMA, 1988).

In 1906, Rio de Janeiro had 800,000 inhabitants, the vast majority of residents without alternative housing sought shelter in the favelas that proliferated as a result of migration caused by the supply of work in small industries and, in particular, in civil construction. At this time, the dismantling of Morro do Senado and Morro do Castelo opened up options for new landfills that modified the contour of the bay, forming Aterro do Flamengo, Largo da Glória and Bairro da Urca. The industrial process intensified, but urban expansion did not receive financial support for the implementation of an infrastructure capable of meeting the needs of the population, whether in terms of decent and safe housing or in terms of environmental safety. This situation influenced the poor quality of the environment both inside the Bay and in the river basins that flow into it (Oliveira & Krau, 1976; Valladares, 2000).

The consequences of these changes can be observed to the present day. The

environmental situation of Guanabara Bay is extremely worrying, as this bay is not an autonomous geographic accident, it depends on the sea to renew its waters daily. The Bay is also the final receiving body for all liquid effluents generated on its banks and in the basins of 55 rivers and streams that feed it, maintaining a relationship of interdependence with the various ecosystems integrated into it (FEEMA, 1988).

The quality of the waters of the bay is, therefore, directly influenced by the load of pollution released in the rivers of its surroundings and in its water mirror. Human activities contribute as the main source of this pollution, since there are approximately 14,000 industrial establishments, 16 maritime oil terminals, 2 commercial ports, 12 shipyards, 2 oil refineries, more than 1,000 gas stations and an extensive transport network for raw materials, fuels and industrialized products circulating around them in highly congested urban areas (ibid, 1988).

THE INFLUENCE OF HUMAN ACTIONS ON THE ENVIRONMENTAL DEGRADATION OF GUANABARA BAY

The main causes of the environmental degradation of Guanabara Bay are: deforestation, the destruction of mangroves, landfills, inefficiency in the collection of urban waste and the final destination, industrial pollution and environmental accidents.

The destruction of the Atlantic Forest also contributes to this accelerated process of environmental degradation. The remaining area of the Atlantic Forest in the State of Rio de Janeiro is restricted to only 1,265 km², corresponding to 37.5% of the original. In the period from 1995 to 1997, there was a reduction of 577 hectares of forest areas in the State, the equivalent of a football field per day. From 1984 to 1991, urbanized areas in the

Guanabara Bay basin region expanded by 87 km², while forests were reduced by 95 km² (FEEMA, 2002).

The lack of housing for the vulnerable population resulted in the occupation of forest areas unsuitable for urbanization, such as hillsides, river banks and floodplain areas. A statistical survey carried out in the Tijuca National Park area indicated the emergence of 46 new favelas in a two-year period (1995-1997). In addition to the destruction of the fauna and flora of the deforested region, the removal of trees and native plants from the forests unprotects the soil, creating conditions for landslides caused by floods, which ends up leading to silting and obstruction of rivers with mud and garbage, contributing to the occurrence of floods in urbanized areas (ibid, 2002).

The destruction of mangroves, considered a primordial habitat for the maintenance of the life of aquatic animals, also occurred at an accelerated rate. And of the 260 km² of original mangroves, only 82 km² remain in Guanabara Bay. The silting process, which intensifies over time, results in a progressive reduction in the depth level of the Bay. This process destroys the environment, reducing the reproductive capacity of several aquatic species, such as oysters and mussels (Costa, 1994; Amador, 1996).

The landfills promoted by the urbanization process of Rio de Janeiro were responsible for the reduction of 30% of the original surface of the Guanabara Bay. These interferences in the natural environment caused alterations, some of them irreversible, in the water circulation system, drastically reducing the self-purification capacity of the Bay and causing inestimable damage to aquatic life animals, directly affecting the quality of human life (Oliveira & Krau, 1976).

The deficiency of the basic sanitation system, aggravated by the lack of treatment

of sanitary sewage, represents an important source of pollution in the Bay. The collection networks are not enough and the predominance of open sewage in poorer areas favors the arrival of raw sewage in Guanabara Bay, as a natural receiver of all rivers, canals and galleries in the city of Rio de Janeiro (Sissino & Moreira, 1996).

Additionally, the lack of collection and the lack of adequate places to receive domestic waste and industrial, hospital and laboratory waste constitute a problem with wide repercussions for public health. Human waste allied to tailings and organic and inorganic waste are the focus of several infectious and parasitic, bacterial and viral diseases, and may also represent a risk of human contamination by toxic and radioactive materials that can, among other diseases, cause cancer. The accumulation of these residues without treatment promotes soil contamination and, consequently, the pollution of surface and groundwater, also causing the obstruction of drainage systems, causing floods with enormous risks to human and animal health (Moutella, 2001).

Adding to the risks of environmental accidents such as oil spills, which occur relatively frequently in refineries, commercial ports, shipyards and gas stations, the environmental situation becomes disastrous and increasingly worrying. In 2000, 1.3 million liters of oil spilled directly into Guanabara Bay, affecting the marine ecosystem and causing the death of several aquatic animals, further destroying mangroves and polluting coastal beaches. In addition to harming the resort and tourism, environmental disasters such as this one have caused economic damage to workers who subsist on fishing, causing problems for environmental health with the contamination of microorganisms, some of which are responsible for outbreaks such as cholera and salmonellosis, and

reducing population's quality of life (Colwell, 1996).

POLLUTION OF THE AQUATIC ENVIRONMENT AND CONSEQUENCES FOR FOOD SECURITY

The environment is a physical (abiotic environment) and biological (biotic environment) system in which humans and other animals live, constituting a complex whole with many interacting components within it. Marine biodiversity expresses the total number of genes, species and ecosystems in a region and is invaluable for life on planet Earth (Neves & Tostes, 1992).

From an ecological point of view, aquatic systems are a complex set of diverse subsystems in which biological processes and ecological relationships interact that, integrated with each other and with the outside, determine the total behavior of the ecosystem. The main causes of loss of marine biodiversity are habitat degradation and fragmentation, invasion of species introduced into environments that are not their natural habitat, overexploitation of living resources, pollution, overfishing and global climate change. In association with the aforementioned causes, there are fundamental factors that have led over the years to the loss of global biodiversity and, in particular, of marine biodiversity. Among these factors we can include the high rates of population growth and the consumption of natural resources without planning (Amaral & Jablonski, 2005).

The dumping of raw sewage and industrial waste directly into the natural waters of Guanabara Bay is one of the main causes of destruction of the aquatic habitat. The rainwater that flows into Guanabara Bay contains (due to the process of disorderly urbanization, lack of basic sanitation

and garbage collection), millions of microorganisms per milliliter, leaving the microbiota composed of autochthonous and enteric bacteria that end up being released in the aquatic environment through domestic effluents. This contamination causes problems for public health: risks associated with the contamination of spas and the consumption of marine or estuarine foods from these areas (Paranhos et al., 1995; Pinheiro Jr. et al, 2002; Sá, 1999.).

In Brazil, the main species of molluscs are oysters, commonly consumed in natura with a few drops of lemon, and mussels, consumed after being lightly cooked. Oysters and mussels are microphagous animals, that is, they feed on particles and microorganisms suspended in water, but they are not qualitative food selectors. These animals are able to filter 5 liters of water per hour and the level of nutrient absorption is closely related to the temperature, salinity and healthiness of the environment they inhabit. These characteristics are important because their consumption, without prior heating, can transmit a series of pathogens to humans, becoming a risk to public health. It must be noted that if the environment is polluted with pesticides and heavy metals, these substances will not be eliminated by cooking. This type of pollution represents one of the most harmful factors to the aquatic ecosystem and the only way to improve the quality of consumption of these animals is the purification process, which consists of inserting them still alive in a clean aquatic environment (Bussani, 1983; Ribeiro, 2000).

Oysters and mussels can be found on natural shores or embankment stones within Guanabara Bay. It is common to find a higher proportion of these animals near the entrance to the bay where the high density of algae serves as a substrate for their fixation. The cultivation of these animals is an activity that

depends on environmental dynamics and negative factors, resulting from pollution or even in accidental situations, where toxic effluents are spilled, will influence the volume of production and the receptivity of the product by the consumer market. The preservation of the aquatic environment is a matter of quality of life for society and future generations, but for fishermen and riverside populations it is a matter of basic and urgent need, since it is from this environment that they and their families derive their livelihood (Santos, 1982; Peresi et al, 1998)

The main sources of contamination of oysters and mussels occur through the spillage of sewage and industrial waste into the environment and this leads to contamination by organic matter, microorganisms (bacteria and viruses), oils, detergents, non-biodegradable products and heavy metals responsible for causing intoxication and in some cases favoring the development of cancer. Microorganisms and heavy metals are considered the most dangerous contaminants because they do not always cause apparent or immediate changes and molluscs, although contaminated, can be considered fit for consumption (WHO, 1975; Hackney & Dicharry, 1988).

The contaminated aquatic environment provides food that is unsuitable for consumption, since many diseases are transmitted to humans by various microorganisms, through the ingestion of fish and marine bivalve molluscs (oysters and mussels) not submitted to cooking or insufficiently cooked. This contamination can occur directly through water, or indirectly during the consumption of contaminated fresh products and in the preparation processes that involve handling, storage and transport (Wood, 1976; FAO, 1978).

Studies indicate that outbreaks of diseases related to the consumption of fish, molluscs

and derivatives vary according to the population's eating habits and the local climate. These food outbreaks are more frequent in the summer when the water temperature is higher. In Japan, about 70% of Food Transmitted Diseases (DTA) are associated with the consumption of uncooked fish. In the United States, since the year 1800, more than 400 outbreaks with 14,000 cases have been described, representing 11% of ATDs. These outbreaks generally occur due to the presence of pathogens in the habitat of aquatic animals associated with deficiencies in the production process or by cross-contamination of foods, with special emphasis on those that are consumed raw (Rippey, 1994; Doyle, 1994).

PRESERVATION OF THE ENVIRONMENT IN THE CONTEXT OF FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

The Federal Constitution of the Brazilian Republic (1988) met by environmental legislation, State and Municipal Master Plans, aim to generate instruments to protect the environment, guaranteeing access to information by society. The most important principle is that of repair:

“Conduct and activities considered harmful to the environment will subject violators, individuals or legal entities, to criminal and administrative sanctions, regardless of the obligation to repair the damage caused.” (CFRB, art.225, VII § 3rd, Brazil, 1988).

According to CRFB (1988) the environment is a heritage for common use by the people and, therefore, represents a social wealth to be preserved by all. Based on this principle, Law No. 6,938 (Brasil, 1981) established the principle of strict liability in cases of environmental damage. This way, those responsible for damages caused to the environment, regardless of the intention or not to cause them, must be held civilly

and criminally liable and obliged to repair the damage. The immediate application of environmental laws, in turn, is carried out by the Executive Branch, which must be acting in order to avoid and/or punish crimes of environmental degradation.

Any change, favorable or unfavorable, in the environment or in any of its components, resulting from a certain action or activity is considered by Brazilian legislation (Brasil, 1986) as an environmental impact. This change may affect directly or indirectly the health, safety and well-being of the population, social and economic activities, biota, aesthetic and sanitary conditions and the quality of environmental resources.

The increase in human interference on the environment usually ends up creating conflicts between human goals and nature's own processes. In order to avoid damage to the environment, it is important to carry out an environmental impact assessment, an activity designed to identify and predict the results of an action in the biogeophysical environment, in human health and well-being. Among the plans to prevent damage to the environment include environmental education, law enforcement and Environmental Impact Studies (EIA) that provide for environmental changes related to economic activities, estimating the costs to the environment and society. EIAs aim not only to protect the environment, but also to prevent the occurrence of ecological disasters, whether caused by nature or by man. In our country, natural disasters such as hurricanes, earthquakes and tidal waves are very rare, however, those caused by human activities are increasingly frequent. Most of these disasters cause the death of fauna and flora, causing irreparable damage to the ecosystem, to riverside communities that live from fishing and to the entire population of cities whose sources are affected (Brasil, 1986).

The global concern with sanitation and access to drinking water, as well as the preservation of the water quality of oceans, rivers, lakes and springs has reached the Sustainable Development Goals (SDGs) proposed by the United Nations (UN). The SDGs are interconnected and represent a development challenge for humanity, with regard to the themes "drinking water and sanitation" and "life in water" they are addressed in goals 6 and 14 (UN, 2022).

SDG 6 aims to ensure the availability and sustainable management of water taking into account gender issues (Heller, 2022), vulnerability situations, reducing pollution by eliminating dumping and minimizing the release of chemicals and hazardous materials, reducing by half the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally. SDG 14, in turn, aims at the conservation and sustainable use of oceans, seas and marine resources for sustainable development. To achieve this objective, the goals outlined aim, among other goals, to prevent and significantly reduce marine pollution, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts.

In an approach focused on food security, we cannot ignore the growth of poverty in Brazil and the reduction of resources destined to social policies, which contributed to the inclusion of the country in the "Hunger Map" (Salles-Costa et. al., 2022). This situation exacerbates the vulnerability of economically disadvantaged people and even more impacted by the COVID-19 pandemic. In this sense, the preservation of aquatic environments is important to guarantee the economic activities of riverside populations and artisanal fishermen who subsist in this highly degraded environment over the years.

In summary, in a broader perspective, the environment is also influenced by climate

changes that modify the places where we live, affecting health, access to food and causing a decrease in species, including those of aquatic habitat (Barcellos et al., 2022). Therefore, preserving the environment is an action that is the responsibility of society and the Government, both of which must be permanently attentive so that this action is effective. Protecting the environment is one of the ways to preserve biodiversity and improve society's quality of life and health (Neves & Tostes, 1992).

CONCLUSION

Aquatic ecosystems subjected to pollution or contamination can bring serious health

problems to humans. Bacterial food poisoning certainly represents the most common consequence related to the consumption of fish and bivalve molluscs from polluted areas. However, there are risks of various diseases caused by parasites, biotoxins and chemical poisoning. The presence in aquatic ecosystems of heavy metals and pesticides that are carcinogenic agents can expose people to the risk of developing cancer. Public policies for environmental preservation and the adoption of appropriate technical procedures for the cultivation, processing and consumption of fish and bivalve molluscs constitute, among other measures, essential actions to minimize the identified risks and increase food safety.

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