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Evaluation of environmental impacts generated by cemetery in pandemic period: Case study

Eduardo Antonio Maia Lins[1*], Adriana da Silva Baltar Maia Lins[2]
[1] Department of Environmental Engineering, Catholic University of Pernambuco, Pernambuco, Recife, Brasil
[2] Center for Exact and Statistical Sciences, Federal University of Paraíba, João Pessoa, Paraíba, Brasil

Abstract
Nowadays, the quality of life and urban environmental problems are correlated, since urbanization brings problems that affect the life of the population. It is now known that any change in the environment reflects a chain of consequences. In this sense, cemeteries can be a source of environmental problems. This work aimed to present possible environmental impacts generated by a cemetery during the pandemic period, having as a case study the public cemetery of Parque da Saudade, Pernambuco, Brazil. The subsidies used were collected through technical visits and preparation of the Leopold Matrix. It was found that 18 elements and 9 actions were evidenced, resulting in a total of 168 squares. In summary, a total of 9 environmental impacts related to the cemetery were obtained. It is observed that the highest degree of severity of negative impact is associated with the spillage of the necrochorume, followed by the coronavirus.

Keywords: health, environment, Coronavirus, corpses, Leopold headquarters

1. Introduction

[1] Chronologically, cemetery buildings in antiquity went to Christian catacombs. It was on the walls of the underground galleries that tombs were made to bury the dead and also the place used by the first Christians to meet secretly in the period when they were still being persecuted. Burial on land had an important meaning, as a religious perspective led to the preservation of places considered holy, and the cemetery became one of those spaces. In view of this, being buried next to these tombs meant protection for the moment of awakening, having this thought based on the belief that the saints had a guaranteed place in paradise. The concealment of a corpse doomed to decomposition, whether by burial, embalming, cremation, deposition in caves or other forms, was a sociocultural practice of preserving the dead and also the living himself, who would not have to witness an anticipation of his degrading finitude. Remnants of prehistoric burials denote man's concern with the post-mortem, the beginning of a spirituality, through funerary rituals and practices [2].

Nowadays, quality of life and urban environmental problems are correlated because urbanization is a fact that brings problems that affect the life of the population. It is now known that any change in the environment reflects a chain of consequences. These changes influence the quality of the urban environment and, consequently, the quality of life of people. In this sense, cemeteries can be a source of environmental impacts. In the construction of most cemeteries in Brazil, there are practically no environmental impact studies carried out since many were originated even before the creation of the National Environment Council [3]. Considering that the quality of life and environmental problems are interconnected, any change in the environment has consequences in the urban environment, causing impacts that affect the quality of life of the population [4, 5] proves that cemeteries can be a source of environmental impacts, presenting a high potential for pollution and contamination, which can be increased depending on the location and management method.

After death, corpses produce and release large quantities of substances from the putrefaction process such as: hydrogen sulphide (H_2S), carbon dioxide (CO_2), methane (CH_4), ammonia (NH_3), Cadaverina and Putrescina, responsible for the smell rotten meat, in addition to phosphine (PH_3) [6], where most of these substances have a high degree of contamination and environmental pollution. Studies of [7] at the Botanical Cemetery in Australia provided an opportunity to assess groundwater conditions near recent burials. The results showed a definite increase in electrical conductivity (or salinity) close to recent graves. High ions of chloride, nitrate, nitrite, ammonium, orthophosphate, iron, sodium, potassium and magnesium were found under the cemetery. In his study, he also found that groundwater samples in older deposits had remarkably similar compositions. Three cemeteries in Woronora, The Necropolis and Guildford, Australia, were also examined for their potential for pollution by the authors. The results of these investigations showed no significant presence of pathogens, except for Pseudomonas aeruginosa, a pathogenic bacterium responsible for water-borne diseases. The Sars-Cov-2 coronavirus can be added to the necrochorume product.

Recent studies [8, 9] have suggested that SARS-CoV-2 persists in aerosol for approximately three hours and on surfaces for up to nine days, which supports the theory that transmission only by droplets or fomites would not justify such potential for rapid dissemination of viruses in populations. 8 verified the stability of SARS-CoV-1 and SARS-CoV-2 (Covid-19) in the environment and evaluated the possible reasons why the new coronavirus has greater transmissibility between humans, directly or indirectly.

The viability of both viruses mentioned in aerosols in periods of 0, 30, 60, 120 and 180 minutes were investigated

by nebulization, filtration, and infection of Vero cells. Both viruses showed stability in the test for 180 minutes with a slight decline after that period, with a half-life of around 2.7 hours (variation of 1.65 hours for SARS-CoV-1, vs 7.24 hours for SARS-CoV -2).

[9] conducted a systematic review on the biological properties and persistence of different types of coronaviruses and infants for humans (SARS-CoV-1, MERS, HCoV and others) and found that this group of infectious agents can persist on inanimate surfaces such as metal, glass or plastic for up to 9 days.

It is noteworthy that there is a possibility of virus persistence in the skeletons, according to studies carried out [10] that identified specific proteins of the blood and human organs in the ceramics that have kept organs from cadavers since the Iron Age. The presence of these peptides, for example, helped the Crimean-Congo hemorrhagic fever virus (CCHFV) to bind to a host cell. Everything indicates that the presence of CCHFV in an iron age clay vase represents evidence of a persistent biological element.

In view of the above, this study aimed to present possible environmental impacts generated by a cemetery during the pandemic period and possible impacts during the exhumation of corpses hypothetically contaminated by the presence of Coronavirus in human skeletons and / or necrochorume, taking as a case study the public cemetery of Parque da Saudade in the municipality of Afogados da Ingazeira, located in the hinterland of the state of Pernambuco, Brazil.

2. Materials and methods

2.1. Study Area

The Parque da Saudade cemetery (Latitude: -7.74041; Longitude: -37.648) is in the municipality of Afogados da Ingazeira in the Pajeú microregion, state of Pernambuco, implanted in 1979, without previous studies, having about 1918 deposits. This is inserted in an urban area, adjacent to residential and commercial areas.

2.2. Methodology

The study started with a bibliographic review based on the relevant legislation on the topic, supporting the development of the study. The subsidies used to analyze the situation in the area were collected through technical field visits with photographic records, informal interviews with the administrators and employees of the analyzed cemetery. A visit was also made to the Municipal Department of Infrastructure, the body responsible for administering the cemetery in the municipality.

For a more detailed analysis and visual representation of the data obtained, the Microsoft Office Excel program was used to create the graphs and data tabulation. Due to the complexity involved in the diagnosis of environmental impacts, it was necessary to have a holistic view in the analysis of the data, applying the Leopold Matrix to identify and analyze the negative impacts generated and their consequences for the environment.

The environmental impact classification was defined through the relationship between degree of importance versus severity, providing the final category. The environmental factors evaluated refer to soil, water and living beings. An adaptation was made regarding the score of the degree of importance, being considered points ranging from 1 to 5, where the number 1 corresponds to the condition of less importance and the number 5 corresponds to the maximum values of these attributes.

3. Results & Discussion

The cemetery has approximately 1918 deposits, the vast majority of which are for burial. In addition, it is considered the largest in the city. The construction of the tombs does not involve any type of special material, being constructed of sand, cement and bricks, without any waterproofing, presenting numerous cracks and cracks through which gases and necrochorumes escape (Figures 1 and 2). However, Art. 6 ° [11], establishes that the construction of the tombs must obey technologies that prevent the passage of gases and the leakage of liquids from the colliquation.

Fig 1: Poor conservation of the tombs - Afogados da Ingazeira - PE - Brazil. Source: The authors.

The risk of microbiological contamination with the construction of cemeteries in an urban environment is presumed. Groundwater is most affected by contamination by viruses and bacteria. Natural springs or shallow wells connected to the contaminated aquifer can transmit waterborne diseases such as tetanus, gas gangrene, food-borne infection, tuberculosis, typhoid fever, paratyphoid fever, hepatitis A virus, among others. The poor and low-income population is more likely to be infected by these diseases. They usually live in regions where there is no access to the public drinking water network and have a low natural immune system [12].

Fig 2: Presence of cracks and fissure – Afogados da Ingazeira – PE - Brazil. Source: The authors.

The decomposition of human tissues and organs by enzymes and bacteria will depend on the local anaerobic condition as well as the type and quantity of drugs used by the corpse when in life. Such a process is known as destructive transformational phenomena, where each phenomenon or stage will be subject to different durations due to the peculiar variations mentioned above [14] after death, each

decomposed body releases around 30 to 40 liters of necrochorume, a neologism that is technically and scientifically known for its colliquation product, created by analogy to the leachate from organic waste in landfills. [15] defines necrochorume as a viscous solution, composed mostly of water, rich in mineral salts and degradable organic substances.

Covid 19 has been persistent in the sewer. In Brazil, in large cities such as Belo Horizonte and Florianópolis, the presence of the virus was found in monitoring samples carried out at different points. In Belo Horizonte, for example, according to researchers from the National Institute of Science and Technology (INCT), located at the Federal University of Minas Gerais (UFMG), from the 24 sampling points the incidence of the new coronavirus (covid-19) was presented.) in 100% of the sites, increasing significantly in the Ribeirão da Onça Basin, where the presence of the virus reached 88% of the samples collected between May 11th and 15th, 2020. There are three possible hypotheses of what happened: coronavirus present in the faeces it contaminates the water with which the people have contact, or the sewage or the contaminated feces, somehow, reach a certain surface - and the contact with it can pass the virus Transmission by vectors (insects, for example, hypothesis for the which has not yet been confirmed, since the possibility of contamination of the sewage by the coronavirus is possible, the certainty of the presence of the virus in the necrochorume generated by patients affected by the disease is almost certain. The effects of the current pandemic experienced on the planet can only be clarified after a few years of study. However, what awakens in the research carried out by [16, 17, 18] is the real possibility for a short period (time of exhumation of the bodies) to become evident with the presence of the New Coronavirus in greater or lesser abundance.

Thus, with all the information and records obtained, it was possible to set up the Leopold matrix (Chart 1) to analyze the possible negative environmental impacts that could be generated by a cemetery that received corpses with the new Coronavirus. The Leopold Matrix elaborated where it was completed based on the inspections carried out and documentary data on the area. It was possible to verify that, in total, 18 elements and 9 actions were summarized. The matrix of the present study was composed by the crossing of 18 environmental components (columns) and 9 potentially impacting actions, resulting in a total of 168 squares.

In summary, a total of 9 environmental impacts related to the cemetery were obtained. It is observed that the highest degree of severity of negative impact is associated with the spillage of the necrochorume, followed by the coronavirus. Fact explained by the high potential pollutant of the effluent that putrefaction contains high amounts of different bacteria, such as those that cause tetanus (Clostridium tetani), gas gangrene (Clostridium perfringes), typhoid fever (Salmonella typhi), parasitoid fever (Salmonella paratyphi), dysentery (Shigella dysenteriae), viruses such as those of hepatitis and possibly the coronavirus. Heavy metals, formaldehyde and methanol used in embalming are also present and may contain residues from hospital chemical treatments [19].

			Elements of nature																		
			Características Físico-Químicas							Condições Biológicas				Fatores Culturais					Relações Ecológicas	
			Terra		Água			Atmosfera		Flora		Fauna		Interesses		Cultura				
			Physical Properties	Chemical Properties	Surface water quality	Drained water quality	Groundwater quality	Dust	Toxic gases	Trees, shrubs and grasses	Other Native Vegetables	Birds	Other Native Species	Landscape Pattern	Tourism	Health and Environment	Employment	Future Generation	Food Chain	Relationship Fauna and Flora
Actions	Modifications	Flora	-4	-5	-5	-5	-5	-2	-4	-2	-2	-2	-3	-5	-5	-5	-1	-5	-4	-4
		Fauna	-4	-5	-5	-3	-3	-3	-4	-2	-2	-2	-5	-5	-5	-5	-1	-5	-4	-4
	Transforming Agents	Coronavírus	-5	-5	-5	-5	-5	-5	-5	0	0	-3	-5	0	-5	-5	-5	-5	-5	-5
		Dead Bodies	-1	-3	-3	-3	-3	-3	-5	-1	-1	-1	-1	-5	-5	-5	-5	-5	-5	-5
		Toxic and Polluting Gases	-3	-3	-3	-5	-3	-5	-5	-3	-3	-2	-2	0	-4	-4	-4	-4	-1	-1
		Necrochorume	-5	-5	-5	-5	-4	-5	-5	-5	-5	-2	-3	-5	-5	-5	-5	-5	-5	-5
	Operation Required	Remediation	2	2	2	2	2	2	2	3	3	3	3	-5	-2	-1	3	1	1	1
		Monitoring	0	-1	-1	-1	-1	-1	0	0	0	0	0	-5	0	-1	3	-1	-1	-1
		Cleanliness and conservation	0	0	-1	-1	-1	-1	0	1	1	1	1	-5	0	-1	3	-1	-1	-1

Chart 1: Leopold Matrix for the Parque da Saudade Cemetery – Afogados da Ingazeira – PE - Brazil.

Also, according to the matrix, it is possible to observe the predominance of negative environmental impact in relation to the analyzed factors, such as cultural and ecological, encompassing the physical and chemical characteristics of

the environment and their ecological relationships. For a better visualization, Figure 3 presents a more succinct analysis of the impacts based on the matrix performed.

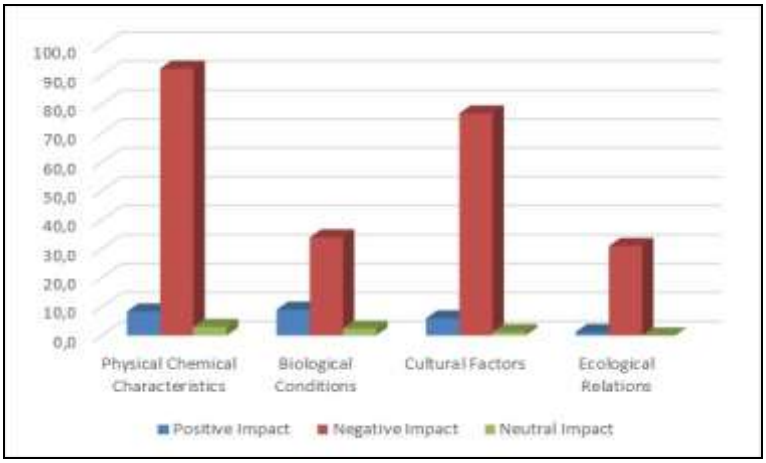

Fig 3: Main Impacts - Parque da Saudade Cemetery, Afogados da Ingazeira - PE - Brazil. Source: The authors.

As for the aspect of modifications or alterations in the environment, it is suggested that the fauna and flora may suffer impacts of high magnitude, mainly associated with erosive processes (already existing) and possibly with the necrochorume, where, only with physical-chemical analyzes carried out on site, it will be possible to verify the real magnitude of this negative impact.

As for the necessary operation, the remediation of the areas is essential for the rescue of the impacted landscape, and may bring other positive impacts, mainly from a socio-economic and environmental aspect.

In turn, analyzing the influence and possible environmental impacts brought by the coronavirus present in the cemetery through the necrochorume and / or human skeletons presents a bleak perspective as to the risks and direct and / or indirect impacts that could bring humanity.

4. Conclusion

The application of the matrix tried to show the functioning of the cemetery, demonstrating the links between the environmental elements, social and political agents. Various data were selected for the application of the matrix, but the difficulty in accessing the information that should be public, the lack of others and even the non-authorization for data transfer, hindered a more detailed analysis.

If Coronavirus persists during the period of exhumation of corpses, the cemeteries will be considered great hosts of a disease that has left thousands of dead today on the planet, making it necessary to properly use PPE for employees and visitors, as recommended by the Ministry of Health: Beanie; Goggles or face shield; Long sleeve waterproof apron; Surgical mask; Gloves; Waterproof boots.

The lack of management of solid waste generated by exhumation, visits and refurbishment of deposits are still real problems in most cemeteries in Brazil and can cause significant impacts on human health and the environment. It is necessary to consider that these residues can serve as foci for fungi and bacteria, especially if they are residues from human bodies derived from highly contagious diseases such as the new coronavirus.

In the cemetery studied, there is a notable lack of minimal sanitary and environmental care required by Brazilian legislation, which can generate significant environmental impacts for the environment and public health, as observed in the Leopold matrix. The liquid and gaseous effluents generated by the putrefaction process can contaminate the soil, surface, and underground water bodies.

5. References

1. Klein HF. Monumentos à memória dos que morreram: as necrópolis e seu impacto Ambiental, Monografia (bacharelado), Universidade de Brasília, Departamento de Administração, EaD, Brasília, 2010, 45 f.
2. Rodrigues PAC. Duas faces da morte: o corpo e a alma do Cemitério Nossa Senhora da Soledade, em Belém/PA. Dissertação de Mestrado (Mestrado em Patrimônio Cultural), IPHAN, Rio de Janeiro, 2014, 425 f.
3. Brasil. Conselho Nacional do meio Ambiente. Resolução nº 001, de 23 de janeiro de 1986. Dispõe sobre critérios básicos e diretrizes gerais para a avaliação de impacto ambiental.
4. Lins EAM, Lins ABM, Souza JM, Melo DCP, Paz DHF. P. Uma Análise Aambiental dos Impactos Negativos Gerados pelo Cemitério de São Luís, Escada – PE, 1 Congresso Sul Americano de Resíduos e Sustentabilidade, Gramado, RS, 2018.
5. Kemerich PDC, Bianchini DC, Fank JC, Borba WF, Weber DP, Ucker FE, *et al*. *Revista do Centro do Ciências Naturais e Exatas - UFSM*, Santa Maria Revista Monografias Ambientais - REMOA, V. 13, N. 5: Edição Especial LPMA/UFSM, 2014, p. 3777-3785.
6. Lins EAM, Lins ASBM, Lins CMMS. Negative environmental impacts generated by cemetery: Case study. International Journal of Advanced Science and Research, v. 4, I. 6, 2019, p. 16-19.
7. Dent BB, Knight MJ. Cemeteries: a special kind of landfill. In: Proceedings of IAH Sustainable Solutions Conference, Melbourne, February 1998. Kenilworth, International Association of Hydrologists, 1998.
8. Van Doremalen N. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. 2020. The New England Journal of Medicine, 2020; 382:1564-1567.
9. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect. 2020; 104(3):246-251.

10. Wiktorowicz CJ, Bettina A, Wiktorowicz JE, Murrayd ML, Kuroskyc A. Hemorrhagic fever virus, human blood, and tissues in Iron Age mortuary vessels. Journal of Archaeological Science, 2017; 78:29-39.
11. BRASIL. Conselho Nacional do Meio Ambiente. Resolução nº 368, de 28 de março de 2006. Altera dispositivos da Resolução 335, de 3 de abril de, que dispõe sobre o licenciamento, 2003.
12. Lopes JL. Cemitério e seus impactos ambientais - Estudo de caso: Cemitério Municipal do Distrito de Catuçaba/SP, Trabalho de Conclusão de Curso, Centro Universitário SENAC, São Paulo, 2000.
13. Nascimento WG. Investigação geofísica ambiental e forense nos cemitérios do Bengui e do Tapanã (Belém – PA). Dissertação de Mestrado, Programa de Pós-Graduação em Geofísica, Instituto de Geociências, Universidade Federal do Pará, Belém, 2009, 153 f.
14. Bacigalupo R. Cemitérios: Fontes Potenciais de Impactos Ambientais, Revista História, Natureza e Espaço, 2012, 1(1).
15. Carneiro VS. Impactos causados por necrochorume de cemitérios: meio ambiente e saúde pública. Revista Águas Subterrâneas, 2009; 1:1-11.
16. Herring A, Swedlund AC. Plagues and Epidemics in Anthropological Perspective. In Herring, A.; Swedlund, A. C, Plagues and Epidemics: Infected Spaces Past and Present, 1 Ed., Bloomsbury Academic: Handcover, 2010, p. 1-20.
17. Noymer A. Epidemics and time: influenza and tuberculosis during and after the 1918–1919 pandemic. See Herring & Swedlund, 2010, p. 137-152.
18. Kendall E, Montgomery J, Evans J, Stantics C, Mueller V. Mobility, mortality, and the middle ages: identification of migrant individuals in a 14th century Black Death cemetery population. J Phys. Anthropol, 2013; 150:210-220.
19. Santos AS. Espaços Cemiteriais e suas Contribuições para a Paisagem e Meio Ambiente Urbano. Revista LABVERDE n°6 - Artigo n°04. Jun, 2013.