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DIAGNOSIS OF ENVIRONMENTAL DEGRADATION IN THE AREA OF INADEQUATE DEPOSIT OF MANACAPURU SOLID WASTE – AM

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ABSTRACT

Several destinations can be given as the final disposal of municipal solid waste, however the most appropriate is the one carried out in landfills. However, municipal solid waste is not always receiving an adequate form of final destination, being discarded in dumps, which are old and recurrent practices in Brazilian municipalities, which is based on the dumping of waste in inappropriate places and without any treatment, which has caused environmental, economic, social and public health impacts. This article aimed to develop a quantitative and qualitative diagnosis of environmental degradation in the area of the Manacapuru /AM dump. Initially, reference was surveyed through research in scientific articles and interviews with managers of the municipality. Subsequently, the area was previously diagnosed through on-site visits and observations that allowed describing the main environmental impacts present in the area, the diagnosis was made through leopold's check list and matrix methodology and proposed measures aimed at mitigating the area. Based on the results, the main impacts diagnosed were contamination of soil, air, water resources, loss of fauna and flora, risks to waste pickers and impact on public health. As a repair measure, bioremediation and reforestation with key species for the possible recovery of the area thus making it an area of preservation in the future.

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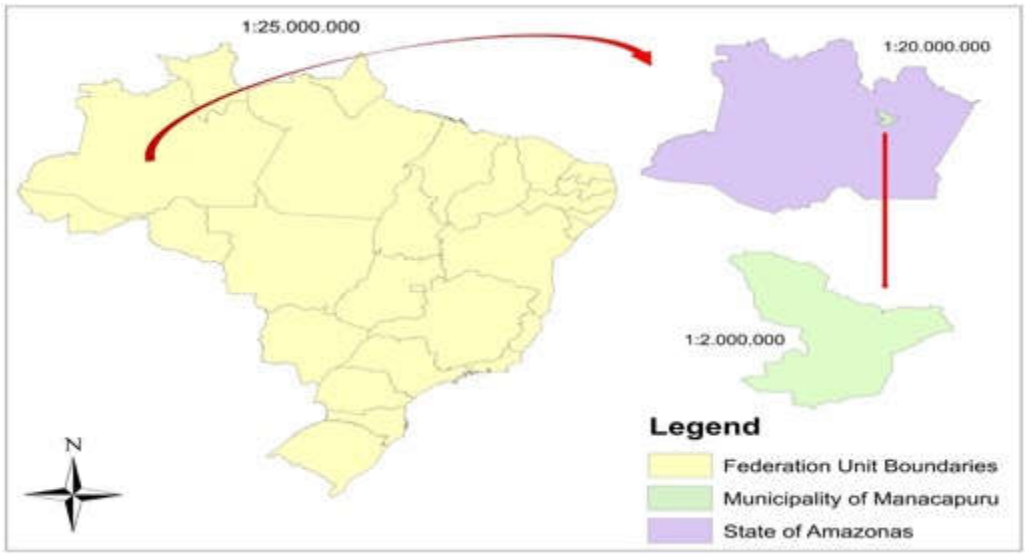
INTRODUCTION

Population growth and the process of disorderly urbanization in cities have caused significant physical changes to the environment (BEZZERA, 2018). The impacts caused by this exponential increase in the population range from the disposal of solid and liquid waste generated by these and industries, to the consumption of natural sources, such as water resources, fauna and flora (DIAS, 2012). However, the generation of solid waste is an inevitable process, where the first civilizations already changed the environment to which they lived and therefore already generated waste. Even before this is the industrial revolution that occurred in the seventeenth century responsible for the great impulse in the generation of solid waste (SILVA, 2016). In 2017, the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE) reported in the National Solid Waste Panorama the results referring to the final disposal of waste collected in Brazilian municipalities. Where 59.1% had their final destination adequate and went to landfills and the remaining 40.9% corresponding to 29 million tons of waste were sent to controlled dumps or landfills. Carrying second Silva *et al.,* (2011). During a study on the conditions of dumps in the city of Porto Nacional/TO, Bendito *et al*., (2017) found an improvement in the destination of solid waste in Brazil compared to previous years, however, emphasizes the need to improve the conditions of collection, treatment and final distinction of solid waste. However, Azevedo (2015) shows that dumps in certain circumstances can cause several problems that affect public health and even the degradation of the environment. In addition, the author also shows that the accumulation of waste can lead to the proliferation of vectors, because the dumps present themselves as the perfect habitat for them, provided by the amount of food and also shelters for the proliferation of them. Another aggravating factor of the dumps is related to the decomposition of the waste, which combined with some factors, results in a characteristic color and odor liquid, with high soil and water contamination content (BASTOS, 2011). As part of this problem, the National Solid Waste Policy (Federal Law No. 12,305/10) was created in order to eliminate and reduce possible damage to the environment.



Source: MARTINS, A.K.B

Figure 1. Location map of the municipality of Manacapuru-AM

In addition, the law addresses the correct and appropriate form of destination for solid waste. For Figueiredo (2013), it is not enough to just eliminate solid waste in landfills aimed at reducing environmental impacts. But on the other hand, the amount of waste discarded should be contained and thus adopt rules to reduce, reuse and recycle. However, due to some circumstances such as lack of investments or even negligence of the rulers, most municipalities in the country were unable to implement the idealized models of landfills in order to eliminate the dumps within the time limit imposed by the law (SOUZA, 2013). Thus, environmental diagnosis is an indispensable tool in the investigation of the level of contamination of a given area, such as the dump areas (ARAUJO 2015). Thus, the diagnosis aims to quantify the damage and level of environmental and social degradation suffered by a given area, thus knowing the conditions of the site, in the future one can seek remediation (SETTA, 2016).

However, the reduction of the impacts generated by dumps is not only based on engineering techniques such as relocating waste in another landfill, it is also about ending the impacts it can still generate even after its deactivation (BLESSED *et al.,* 2017). In this context, the article shows the elaboration of a diagnosis donates environmental impacts caused by a dump used for 30 years in the municipality of Manacapuru/AM, to define the risks the population and the environment and proposals for recovery of the area. The dump produces tons of waste daily, thus showing the importance of designing a diagnosis of the area, in order to mitigate the impacts caused by. In view of this problem, this work shows an analysis of the environmental impacts caused by the dump in operation in the municipality of Manacapuru/AM.

MATERIAL AND METHODS

The dump has been in operation for approximately 30 years 4km from the access road of the municipality of Manacapuru, in an area of 146,225.40 m². The municipality is located 70.66 km straight from the capital of the state of Amazonas, at 3°18'33" S and 60º33'21" W the left bank of the Solimões River at the confluence with the mouth of the Manacapuru River, with a population of 96,236 inhabitants (IBGE, 2018). Information on the collection of waste generated in the municipality was provided by the city. Waste called home and commercial is collected by trucks that circulate through the streets of the municipality but does not have selective collection. Initially, a diagnostic study was conducted on the dump through on-site visits, bibliographic research, technical reports, as well as visits to the city hall headquarters to collect information on issues related to the management of additional waste with employees and responsible for the administration of the municipality. Visits to the dump took place from May to June 2019. During the visits, photographic records and visual evaluation were made, in order to make records of the situation of the area (BLESSED *et al*., 2017). After the visit it was possible to identify the degrading actions at the site, in addition, were observed: the neighborhood around the dump; the characteristics of the deposited waste; distribution and accommodation of solid waste; the current conditions of environmental factors (abiotic, biotic and anthropic media).

Characterization and analysis of impacts on the study area

In order to characterize the impacts generated by the dump, the Check List Method, proposed by Sanches (2008), was used, through which the environmental factors were identified in the area, based on the information obtained through the descriptive methodology, being listed subsequently the degrading actions and impacts on the environment both abiotic with biotic and anthropic. Thus, it was possible to associate the impacts of great relevance in the studied area, showing that environmental characteristics were affected by certain actions. Therefore, to qualify and quantify the environmental impacts advent of inadequate disposal of waste, we opted for the use of the Leopold *et al*., (1971)Matrix, adapted by Sanchez (2008). The use of this last impact matrix aimed to fill some gaps observed in the use of the Chek List Method, since matrices effectively relate actions and environmental factors, besides including parameters for impact assessment.

The criteria for identifying the qualitative parameters analyzed are the impacts generated by anthropic actions (Table 1), while those described in Table 1 are those considered quantitative, generated by anthropic or natural action. Thus, table 1 lists the criteria for "Magnitude", classified as low, medium and high. This parameter refers to the degree of impact on an environmental factor, that is, they are criteria that are independent of other environmental factors identified during the study, it is exclusively about the intensity of the environmental factor. At the same time, other criteria presented in Table 1 were also analyzed as "Importance" and

Source: GOOGLE EARTH, 2019 (adapted)

Figure 2. Location of manacapuru dump – AM

Table 1. Qualitative criteria for analyzing environmental impacts

CRITERION	PARAMETERS	MEANING
Order	Direct:	When the impact is considered primary.
	Indirect:	When impact is a secondary reaction of the action being performed.
	Reversible:	When the impacted environmental factor can be recovered.
Plastic	Irreversible:	When the environmental factor, it is not recoverable .
	Positive:	When action is beneficial for improving environmental quality.
	Negative:	When the action results in damage the quality of an environmental factor.
Value	Temporary	When it remains for a certain time, after the action.
	Permanent:	When the action is performed and the effects do not cease manifest ing on a
Dynamic	ImmediateCyclic:	given known horizon.
		The effect is felt at certain periods.
		It comes in the short term.
Time	Short term:	When the effect manifests itself after a certain time that the action was
	Medium term:	performed.
	Long term:	When the effect manifests a long term after a certain time of action has elapsed.
Space	Local:	When the action affects only the site itself and its surroundings
	Regional:	When the effect spreads beyond the site and its surroundings.
	National:	When the effect spreads in a large space .

Source: Sanchez, (2008).

Table 2. Qualitative criteria for environmental impact analysis

IMPORTANCE	MAGNITUDE	SIGNIFICANCE
Notimportant (NP)	Low magnitude (BM	Unsignificant (PS)
1>=x<3	1>=x<3	1>=x<3
Important (IP)	Average magnitude (MM)	Significant (SG)
3>=x<5	3>=x<5	3>=x<5
Veryimportant(MI)	High magnitude (AM)	Verysignificant (MS)
5>=x<7	5>=x<7	5>=x<7

Source: Sanchez, (2008).

"Significance". Regarding the criterion, "Importance", was classified as low, medium and high according to its degree of importance identified, taking into account its influence on the whole of environmental quality, that is, this criterion is related to the relevance of the loss environmental impact interferes with different environmental factors. The criterion, "Significance", has three subdivisions involving the sum of levels of magnitude and importance. Therefore, the more significant the impact, it is concluded that the previous criteria added are at extreme levels. Thus, the significance of the impact was classified as:

Proposition of measures aimed at mitigating the dump area: Subsequently, the identification of environmental damage considered of high significance, mitigating measures were proposed, such as removal of waste from the area, use of bioremediation techniques, and phytoremediation, soil decompression, use erosion control techniques, revegetar the dump area, recover the airs of ecological importance, provide environmental education program and implement a solid waste management plan. These proposed measures were based on Oliveira's studies (2009), on the proposal presented in the technical notebook of the FEAM (2010).

RESULTS AND DISCUSSIONS

In this section will be shown the main results of the research in which a diagnosis of the impact of the open pit dump installed in the city of Manacapuru/AM will be shown. According to information from the municipality of the municipality, the dump has been installed in the region for another thirty years.

Table 3. Qualitative assessment of environmental impacts and their classification

CRITERIA								
Impacts	Affectedfactors	Mitigation	Order	Plastic	Dynamic	Time	Space	Value
Pollution and/or Contamination of the ground	Soil, waterandanthropic	M	D	R	PR	CP	RG	NE
Soilcompaction	Soil, waterand fauna	M	D	R	T	CP	LO	NE
change in Features soil physics	Solo andwildlife	M	D	R	I	MP	LO	NE
Change in Features Soil Chemistries	Solo andwildlife	M	D	R	T	MP	LO	NE
Change in soil biological characteristics	Soiland fauna	M	D	R	T	MP	LO	NE
Acceleratederosion	Soiland fauna	M	D	R	I	CP	LO	NE
Landscapechange	Landscape	M	ID	R	I	CP	LO	NE
Pollution or contamination of water resources	Water, anthropic, fauna and aquatic flora	M	ID	IR	C	MP	RG	NE
Reliefchange	Soil, reliefandlandscape	NM	D	IR	I	MP	LO	NE
Proliferation of macro and microvectors	Anthropic, fauna andlandscape	M	ID	R	T	CP	RG	NE
Air pollutionorcontamination	Air, anthropicand fauna	M	ID	R	P	CP	RG	NE
Reduction or total loss of flora	Flora, fauna, soil, water and landscape	M	D	R	I	LP	LO	NE
Reduction or total loss of native fauna	Fauna	M	ID	IR	I	LP	LO	NE
Wildlife stress	Fauna	M ou NM	ID	R	T	MP	LO	NE
Contaminationofanimals	Nativeandexotic fauna	M	ID	R	C	MP	LO	NE
Pollution or contamination of surrounding areas	Anthropic, soil, fauna, water and landscape	M	D	R	C	CP	RG	NE
Risk of contamination to waste pickers	Anthropic	M	ID	R	I	LP	LO	NE
Impactonpublichealth	Anthropic	M	D	R	T	CP	RG	NE
Bother for theneighborhood	Anthropic	M	ID	R	T	CP	LO	NE
Risksofworkaccident	Anthropic	M	ID	R	T	CP	LO	NE
Devaluation of the surrounding area	Anthropic	M	ID	R	T	LP	RG	NE
Generationof "temporaryjobs"	Anthropic	M	ID	R	T	CP	RG	NE

Legend: M- Mititable; NM-Non-Mititable; D- Direct; ID-Indirect; R- Reversible; IR- Irreversible ; T-Temporary; P- Permanent; C- Cyclic; I- Immediate; CP-Short Term; MP-Medium Term; LP-Long Term; LO-Local; RG- Regional; NA- National; NE-Negative; PE-Positive.

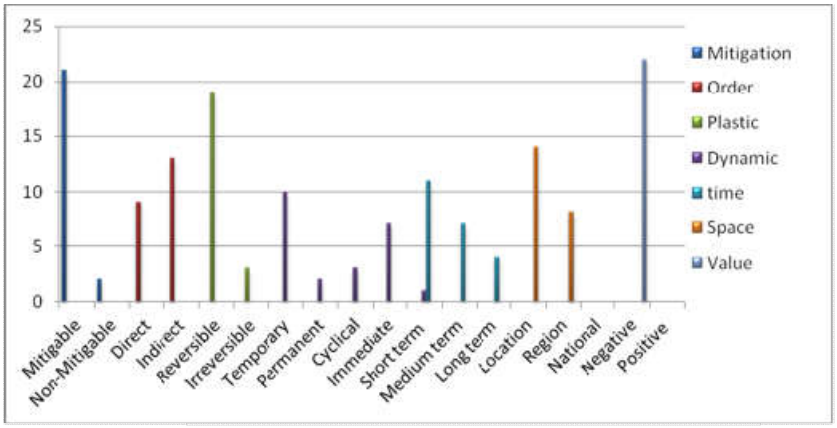


Figure 3. Classification of environmental impacts

According to estimates published in the Municipal Plan for Integrated Management of Solid Waste of Manacapuru are generated daily 98 tons of waste daily. Waste released in the dump originatefrom urban cleaning services, domestic and commercial activities, which together with public waste, represent the largest portion of the RSU collected and produced in the municipality, including waste from street sweeping, cleaning of galleries, remains of pruning and organized free fairs, road waste and small industries allocated in the region. Health Service Waste (RSS) is generated by a single hospital and by the 25 immediate care units in the municipality. Waste collection in the hospital is performed twice a week and only once in the care units. The waste generated by these health units is transported to other municipal solid waste, and subsequently discarded without any adequate treatment in ditches located in the dump. When collecting vehicles reach their maximum processed waste capacity, they go to the dump where waste is disposed of in class separation, when it comes to construction waste, waste is routed to an area responsibility of the city, which aims to use them in infrastructure operations such as the "slap holes". The dump area does not have a protective fence, not inhibiting the entry of animals or people. In the area around the dump, it is possible to observe the existence of waste pickers' residences seeking their livelihood through the collection of products removed from the dump that can be recyclable. The terrain has rugged topography, and is surrounded by native species of the Amazon rainforest. In addition, the region also observes the growing population of macro and micro-vectors, highlighting birds such as vultures, combined with this, the site exudes strong odors from the decomposition of organic matter, which affects the nearest neighborhood locates the approximately 6 km from the dump.

Environmental diagnosis of the study area: It was pointed out as actions that cause possible degradation in the study area the suppression of vegetation for land use, the stacking of

Figure 4. Landscape of waste cells in dump area

Figure 5. Invasive animals in the area of study (Vultures)

waste without engineering technique or even the grounding of these residues without soil waterproofing, and also the issues that involve soil compaction, this due to the entry of vehicles for transport and accommodation of waste. The impacts diagnosed after relating anthropic actions were made by the methodology of the "Check list" primary objective of the use of this technique is to observe the degree of contamination of determines area, that is, the risk content that that activity is quantified directly or directly affect both the environment and the population living in the municipality. Thus, for better visualization the impacts were classified as to their value, order, dynamics, time, space, plastic and possibility of mitigating impacts. As can be seen in Table 03, all means mentioned below suffer from anthropic actions arising from activities related to inadequate deposit of solid waste in the municipality of Manacapuru, AM. Being located in the vicinity of Km 2 connecting the city of Manacapuru the city of Novo Airão, the dump generates a strong visual impact for visitors and those who live and transladam in its surroundings. Yet the landscape has been severely modified with the mountains of garbage that each day are larger. The accumulation of garbage on the banks of the road is constant attracting vultures, rats and other animals. The vegetation of the region is formed by native species of the Amazonbiome, considered the one with the largest biodiversity in the world, being therefore extremely important for maintaining the planet's climate.

There was a change in the landscape of the dump and with the diagnosis it was possible to conclude that despite having its negative value, it is possible to mitigate the impacts that it will suffer, but this process occurs in the long term, post when it comes to reforestation to dynamics is much more complex. When it comes to the reduction or even total loss of flora, there is also talk of soil quality, water, landscape, since they are factors that are affected by ecological imbalance, the loss of fauna is not something that can be mitigated is its value is negative (Chart 2). All this modification in flora is due to deforestation without control and soil compaction further aggravates the regeneration process of native species, which seek an environment conducive to their germination. However, Bastos (2013) showed that it is necessary for man to intervene in order for the environment to become appropriate to the regeneration of native species. The impacts considered non-mititable (NM) were related to relief alteration and total reduction/or loss of native fauna, which is acceptable because they are extremely fragile systems. The same criteria designated as non-mitiable were proposed by Azevedo (2015) during an analysis in the Pombal dump in the municipality of Pernambuco (PE). The author pointed out that these impacts are irreversible in some cases. One of the impacts pointed out as negative were those related to accelerated erosion (Chart 2). However, they are indirect impacts caused by the removal of vegetation, that is, the soil becomes more conducive to actions

of the environment, making it susceptible to weathering. On the other hand, trees are used to protect the soil during heavy rains and part of the precipitation is intercepted by their leaves and trunks, decreasing the occurrence of erosions (BASTOS, 2013). In addition to soil erosion and compaction, previously pointed out as factors that alter soil quality in the dump, the large amount of residues considered to be high degree of dangerousness may be altering soil quality. Some impacts, such as soil contamination, relief alteration, total loss of flora among others, were considered as direct impact, as they are a cause-and-effect relationship (Chart 2) (MARQUES, 2011).

that contributes to the increase of global warming. When asked about the burning of waste, managers reported that the practice is not constant and occurs only when the amount of waste generated exceeds the limits of the road that gives access to the dump, functioning as well as a control measure (Figura 5). According to Table 3, the environmental impact caused by soil pollution and contamination that has a high magnitude is 6 points, while the importance of this impact has 7 points, and its significance to the environment of 6.5 points. These results are similar to those found by Bendito *et al*., (2017), during a study in the dump located in Porto Nacional-TO, where the author

Figure 6. Pits in the soil of the Manacapuru-AM dump

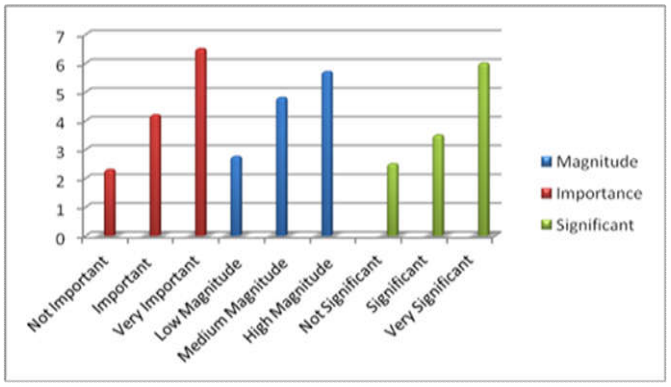


Figure 7. Average qualitative criteria for environmental impact analysis

Table 3. Matrix of quantitative impact analysis

Soil pollution and/or contamination	AM	7	MI	7	MS	7
Soilcompaction	AM	6	MI	7	MS	6,5
Change in soil physical characteristics	MM	3	IP	3	SG	3
Change in soil chemical characteristics	MM	5	MI	6	MS	5,5
Acceleratederosion	BM	2	IP	4	SG	3
Landscapechange	BM	3	NP	2	PS	2,5
Pollution or contamination of water resources	AM	7	MI	6	MS	6,5
Reliefchange	MM	5	IP	4	SG	4,5
Proliferation of macro and microvectors	MM	4	NP	3	SG	3,5
Air pollutionorcontamination	AM	7	NP	2	SG	4,5
Reduction or total loss of flora	AM	6	IP	4	MS	5
Reduction or total loss of native fauna	MM	7	IP	5	MS	6
Wildlife stress	BM	3	NP	2	PS	2,5
Contaminationofanimals	BM	3	NP	3	SG	3
Pollution or contamination of surrounding areas	AM	7	IP	5	MS	6
Risk of contamination to waste pickers	AM	5	NP	2	SG	3,5

Legend: NP - Not Important; IP-Important; VI-Very Important; LM- Low Magnitude; MM-Middle Magnitude; HM-High Magnitude; LS-Little Significant; SG-Significant; VS-Very Significant.

Regarding the opportunistic fauna present at the site, there was a large number of invading animals such as vultures (Coragypsatratus) (Figure 05). Due to the amount of food exposed to its open as remains of animals from butchers located in the region, the dump has become a site conducive to the proliferation of these birds. In addition, species of fauna considered exotic to the environment and vectors transmitting diseases, both for animals to humans, were found (AZEVEDO, 2015). The suppression of vegetation in the dump area also contributes to the loss of fauna that needed that flora for its survival and ends up looking for food in other areas of the municipality, forcing them to seek shelter and food in other regions of the municipality bringing ecological imbalance, another problem that can be observed in Table 3 is the contamination of the fauna that is more of an aggravating, post there may be human contamination through these vectors (AZEVEDO, 2015). Another fact to be observed in the study area are ditches in the soil, forming accumulations of rainwater and slurry from the decomposition of waste, serving as sources of contamination. It is known that in the process of decomposition of waste are generated gases methane (CH4)

found means of 6 points for significance, importance and magnitude, respectively. For Bastos (2011), the high values for the soil contamination parameter was due to a large amount of heavy metals existing in the soil. Requiring efforts, costs, specific techniques and qualified professionals for your mitigation. Regarding the reduction or total loss of the flora (Table 3) the results found are of high magnitude, presenting 6 points. On the other hand, regarding its importance, the values reached 4 points, considering an important impact and 5 points for significance, agreeing with the diagnosis of Araújo (2016), for the sandpaper of Santa Helena in the municipality of Goiás. Regarding air pollution, the results show 2 points, while Gomes *et al*., (2016) in another state (Solânea- PB) also showed the same values. At the same time, Azevedo (2015) shows that activities related to the burning of waste and the decomposition of their organic fraction, release harmful gases into the atmosphere, which are responsible for the increase in greenhouse gases such as methane gas (CH4) and carbon dioxide (CO2). Due to the variety of high hazardous residues discarded in the study area, it is recommended to analyze the chemical, physical and bacteriological properties of water and

soil. Thus, it would be possible to obtain results of the degree of contamination surrounding the dump, and thus plan the best technique for recovery. Additionally, due to the disposal of highly polluting materials such as household appliances, batteries, batteries, fluorescent lamps, heavy metal analyses are required. If analyses of groundwater, surface and soil properties present results at odds with current legislation, decontamination techniques should be applied in areas surrounding the dump. However, the quantity, composition of contaminants, depth of the water table, soil characteristics in order to find the degree of contamination of the area should be taken into account and thus choose the best strategy for the treatment of this liability Environmental.

One of the technical enumerates indicated according to the feam technical notebook (2010), is phytorremediation, a technique whose priority is to remove contaminants from the soil with the use of plants and microorganisms. Thus, it is possible to decrease toxicity from the extraction of these constituents by the roots of plants. Nevertheless, the most used technique for the treatment of depollution of soils and water bodies is inorganic. First, it will be necessary to isolate the area, followed by an identification of the degradation existing in it. This type of technique prevents disposal from occurring after the closure of the dump activities, thus reducing environmental impacts. But for this to occur, it is necessary to have a new place for the relocation of waste. Furthermore, the old dump cannot be used for other purposes because it does not meet technical standard NBR13896/1997, being recommended reforestation and later a preservation area (AZEVEDO, 2015).

Conclusion

This presented a diagnostic study of environmental factors in the open pit dump in the municipality of Manacapuru-AM from May to June 2019. It was possible to observe that the biotic medium (soil, water, flora and fauna), suffered severe degradation due to the removal of vegetation for the accommodation of solid waste. It was possible to diagnose the difficulty of managers in properly managing solid waste produced in the municipality, besides not having a correct treatment and destination, following the National Solid Waste Policy. The installation of a landfill in another more suitable area in the region, requires urgency. In addition to the implementation/improvement of recycling and composting programs in the municipality. For a possible increase in the useful life of a future landfill in the municipality, it is recommended to carry out analyses of water and soil quality that proves the development of the best recovery techniques in the area.

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