International Journal of Future Generation Communication and Networking
Vol. 13, No. 3, (2020), pp. 2935–2945

Case Study on effects of Solid waste management by landfill sites in Bangalore

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Abstract

Municipal solid waste management is one of the foremost issues in urban cities like Bangalore. Intense development in population along with the economy and rising living standards have triggered the creation of colossal amounts of junk, ashes, debris collectively known as solid waste. Amid production of about 5000-6000 tons of waste, proper mobilizing of only 30% is done by BBMP, remnants being taken by private contractors, and the lion's share is consumed by landfills existing in Bangalore North. Due to lack of maintenance of existing landfills, much of it is unserviceable or already ruined immediate milieu causing an outbreak of rage among people. Unacceptable disposal is a hazardous problem advancing in budding nations since waste directly ends up in open landfill dumping affecting numerous health complications. Tests conducted on samples collected from landfills on outskirts of Bangalore North exposed most of the hazardous materials, for instance, lead, chlorine, calcium, magnesium, phosphates, bicarbonates found were crossing permissible limits by a colossal margin causing severe harm to society, which depend on surface water, groundwater and soil.

Keywords:*Landfill, Solid Waste, Waste management.*

Introduction

Maintaining a well-balanced relationship between humans and nature is key to a sustainable and growing environment. During emerging trends and advancing methods of human practices and development, and as much as production plays an important role, maintaining of wastes produced is also a major part. Lack of proper management of wastes can lead to a huge imbalance in nature and makes the environment uninhabitable. The hazard may be painstaking based on the current realm and edge to use in the future. Municipal solid waste emanates from various extents. There are four chief approaches in waste disposal, such as reutilizing, lessening, composting, waste generated in small means, and large metropolises in India. In growing cities like Bangalore, waste production increases exponentially due to emerging living standards, population explosion, and development in industries and IT sectors. Management issues in solid wastes can even effect in pollution of water, air, and soil also. It needs to review the current scenario of Bangalore city for solid waste management and disposal techniques. Studies conveyed this waste creation prolongs to intensify.

Literature review

Wastes produced in Bangalore that are around 5000-6000 tons can be categorized as Organic, Recyclables, E-waste, and debris. Organic waste, being at the top of the list, comprises around 60-70% of total wastes.

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Measures were taken by Govt. of Karnataka include disposal of wastes produced by large organizations like hotels, apartments, railway stations, holy places, aerodromes, at private vendors, or management of left-overs in their own grounds using biogas plants or sewage treatment plants. Individual waste producers such as houses and small shops are directed to dispose of wastes in civic waste accumulators. Even after actions taken by Govt. of Karnataka, only 7-8% of waste is controlled and recycled and rest is discarded in landfill sites in outskirts of Bangalore. Although the design period of landfill sites is 5-10 years, the quantity of waste formed and indecorous management has directed to the closure of many sites and also contaminated its surrounds.

However, recyclable and non-recyclable dry wastes, bio-medical waste and e-waste collectively called as dry waste is managed by around 15-20 dry waste gathering hubs by BBMP. Dry waste is then isolated, and remnants are sent to landfill sites. Due to the presence of around 150-200 informal dry waste assortment spots, which only isolate objects with lofty profits from wastes and remnants are sent to landfill sites. Even though the isolation from these trims down 200-300 tons of waste, leftover menacing and lucrative garbage is abandoned by the informal waste dealers and turn up in landfill sites, this consists of domiciliary plastics, e-wastes such as bulbs, cosmetics, impaired chargers, cords, circuit boards, which are made from toxic elements.

Also, solid waste administration does not involve a discrete zone that sets apart lethal wastes from solid waste accumulated, abandoned worthless waste from informal sites, non-recyclable wastes, and consequently, they reach landfillsites. Also, bio-medicals waste such as sanitary napkins, diapers, perished medications are to be stockpiled and incinerated by appropriate measures as per directives of BBMP. This act is only followed by large apartments, shopping malls, hotels, and large organizations, where this waste is suitably disposed of. Nevertheless, there is a lack of this disposal from individual houses, and it directly reaches landfill sites. These acts reduce the operational efficiency of landfill sites.

Methods and Methodology

Study Area: Bangalore city, India's Silicon Valley, situated in the Deccan plateau's Southeastern side. This city is located at 12.9716° N, 77.5946° E. Average temperature lies between 26.1°C and 15.1°C, while there is an average precipitation of 970 mm. Rivers flowing nearby include Vrishabhavati and Arkavati, and the city is located at an altitude of 920m from sea level. Bangalore is a nucleus for the Information-Technology sector and also most preferred for entrepreneurs and startups. As per the 2011 census, the population was 84 lakhs and has escalated due to plenty of advancement in the IT industry, better climatic conditions, and accessibility of resources.

Segregation of solid waste is one of the biggest crises in Bangalore, although, by measures of BBMP and private waste collectors, only 15-20% of solid waste is segregated before reaching any landfill/dumping yard. Waste collection in Bangalore occurs primarily by Poura karmikas and BBMP workers who collect wastes door-to-door and carried by carts. Then the waste is managed by landfills or by voluntary involvement of Non-Governmental Organizations (NGO's) or by private vendors.

Sampling is a vital process when analyzing or collecting information on the point of interest, where a small group of observations represents the whole of the population to be analyzed. Due to a lack of treatment and segregation of solid wastes, surrounding areas of landfill sites were chosen, and samples of water were collected to analyze the amount of contamination. Samples 1,2,3 were collected from the surroundings of the Mavallipura landfill site near Yelahanka, Bangalore. Samples 4,5 were collected from the surroundings of the landfill in Mittaganahalli, Yelahanka. Samples 6,7 were collected in the surroundings of the Bellahalli landfill site, Yelahanka. It was carefully collected in clean and sterile containers. The samples were analyzed in a laboratory for water parameters with standard methods. Characteristics such as pH, Electrical conductivity, Alkalinity, dissolved solids, calcium, magnesium, potassium, and others were tested, and results were compared with BIS permissible limits.

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Table1: Water quality parameters near landfill sites in Bangalore

Sample number	pH	Turbidity (NTU)	TDS (mg/l)	BOD (ppm)	COD (ppm)	EC (mmho/cm)	F (ppm)	Pb (mg/l)	Zn (mg/l)	Ni (mg/l)	SO_4^{2-} (mg/l)
1	11.6	27.08	9750	1530	1400	18716	1.53	0.31	15.3	1.337	197.1
2	11.9	29.65	11352	1297	1826	7938	1.45	0.43	16.4	1.549	243.8
3	9.3	24.12	6286	920	1593	5945	1.49	0.49	15.4	1.36	253.4
4	12.5	24.62	8654	864	1674	7561	1.51	0.51	14.6	1.493	257.6
5	10.5	28.49	9647	865	1756	8642	1.59	0.35	16.2	1.645	259.4
6	8.2	19.76	10348	648	1208	7564	1.35	0.26	15.9	1.125	243.6
7	9.5	27.19	7613	791	1795	5691	1.6	0.48	15.1	1.264	251.5

Table2: Water quality parameters near landfill sites in Bangalore

Sample number	HCO_3 (mg/l)	NO3 (mg/l)	PO4 (mg/l)	Mg_{2+} (mg/l)	Na^+ (mg/l)	Cu (mg/l)	Ca_{2+} (mg/l)	Fe (mg/l)	Total hardness (mg/l)	Total Alkalinity (mg/l)	Cadmium (mg/l)
1	1674	283	2.06	781	296	1.43	505	5.16	1272	1063	0.17
2	2623	306	2.26	790	362	1.56	620	2.3	560	1320	0.19
3	2356	290	2.18	645	291	1.526	530	1.5	579	1528	0.15
4	2493	246	2.03	679	254	1.648	628	2.74	596	1318	0.17
5	2484	381	2.67	725	346	1.613	597	1.13	648	1164	0.13
6	1937	219	1.6	597	291	1.594	460	1.046	491	941	0.09
7	1964	264	1.95	529	348	1.534	674	2.14	513	1349	0.13

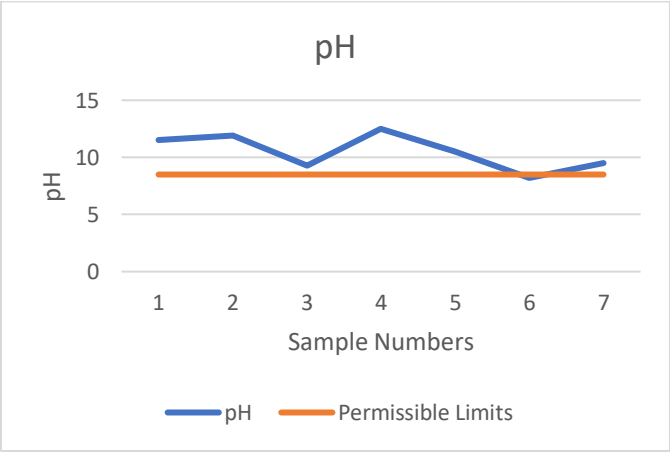

Figure1: Variations in pH

Samples 1,2,3 and 4,5 collected from Mavallipura and Mittaganahalli landfill sites, respectively, indicate a higher pH value, and it is basic in nature.

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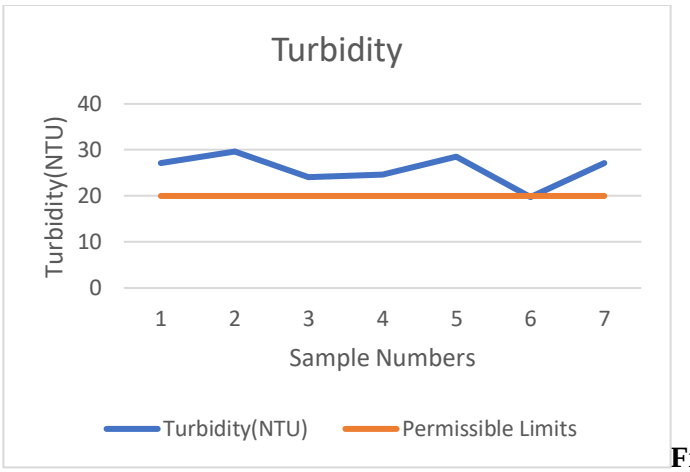

Figure2: Variations in Turbidity

The turbidity of water is a measure of water quality, which shows the number of invisible particles present in water. Samples from 1,2,5,7 indicate higher values of turbidity.

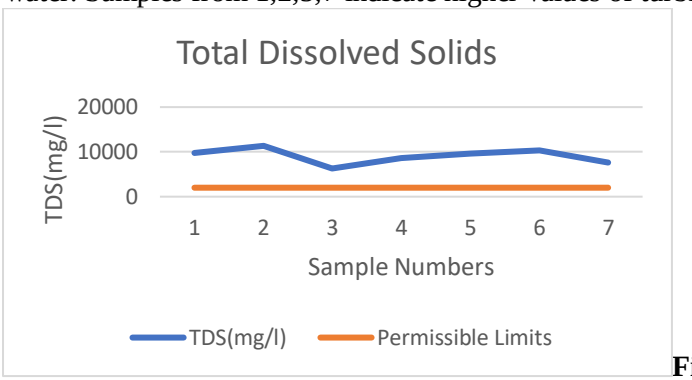

Figure3: Variations in Total dissolved solids

Samples 1,2,4,5,6 indicate elevated values of TDS compared to permissible limits. The immense increase in this parameter causes harmful effects on humans as well as other animals.

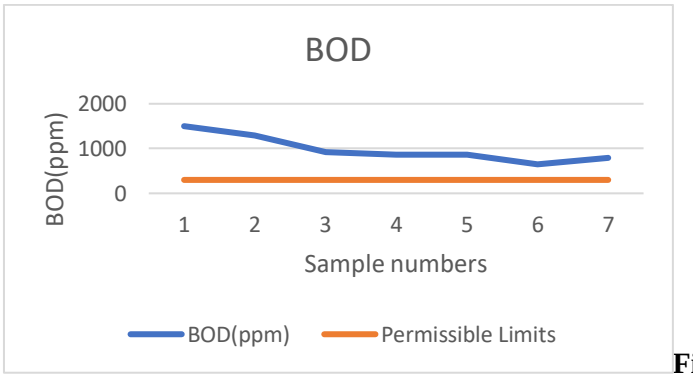

Figure4: Variations in BOD

Samples 1,2,3 indicate an enormous increase in BOD of water. This rise in BOD can diminish the content of oxygen available in water and can lead to the accessibility of less oxygen to life-nourishing in water. This can also affect humans in some fecal problems.

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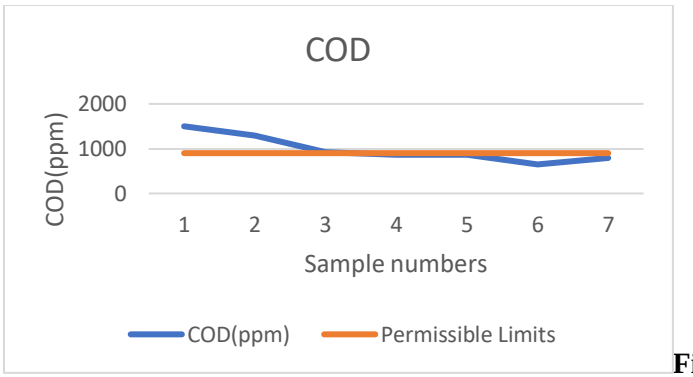

Figure5: Variations in COD

Samples from the Mavallipura site, 1 and 2 show increased COD of water, and these augmented COD values may cause lessening in oxygen, which is dissolved in water.

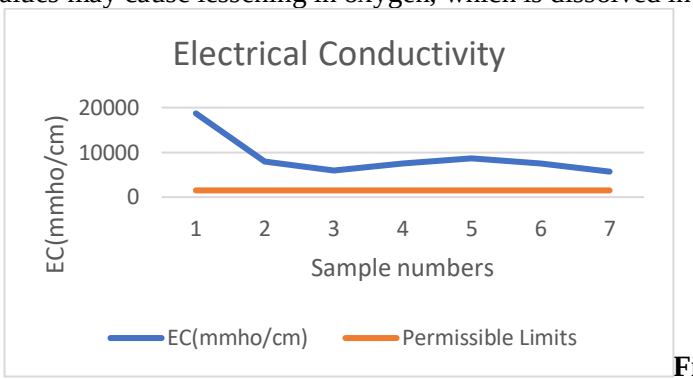

Figure6: Variations in Electrical Conductivity

All of the above samples show an astonishing increase in electrical conductivity, indicating the higher ionic activity of water.

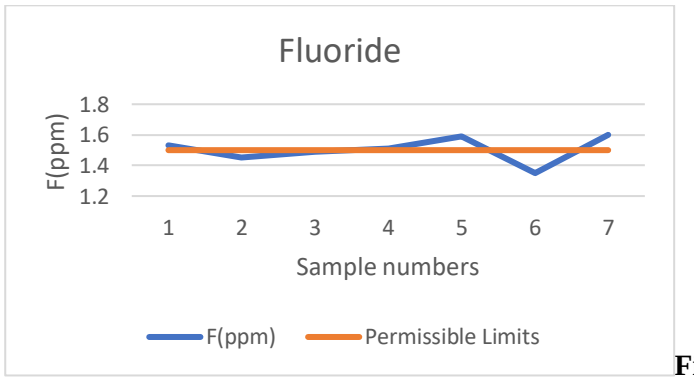

Figure7: Variations in Fluoride

The escalation in fluoride concentrationis seen in samples 5 and 7.Fluoride is one of the most lethal contents in water if it's in ample quantities can cause root dental, abdominal disorders.

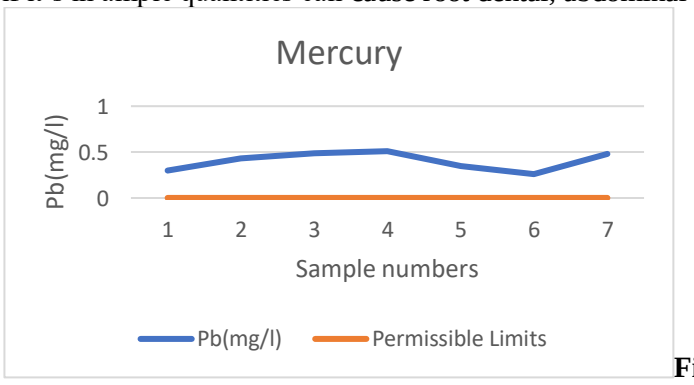

Figure8: Variations in Mercury

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All the samples revealed there was an upsurge in mercury content in the water when compared to BIS Standard limits.

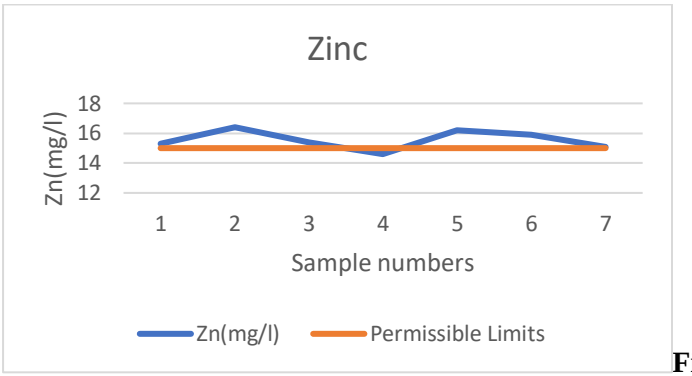

Figure9: Variations in Zinc

Samples 2,5 indicates high zinc contents in water and the presence of zinc in an acute amount in other samples, proper treatment is required to reduce it in other areas.

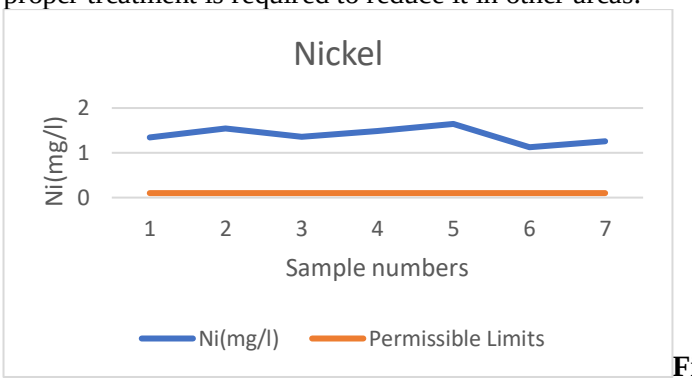

Figure10: Variations in Nickel

All samples show a rise in nickel content. Although, nickel if present in water, is good for health, higher concentrations can be harmful and can be oncogenic.

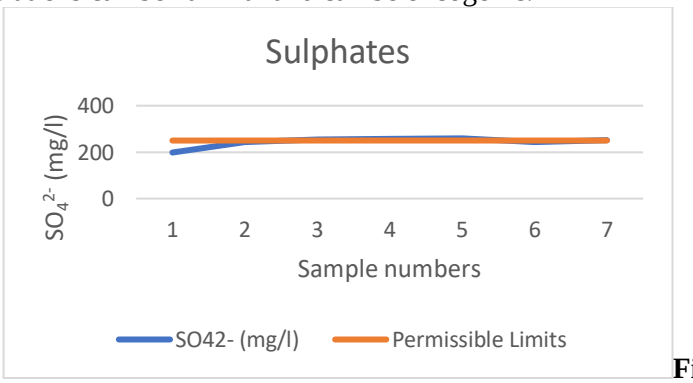

Figure11: Variations in Sulphates

Tests show that sulphates were limited to standard allowable values, and an increase in its content should be controlled further. Sulphates can also cause the development of scales in water ducts and is detrimental for newborns.

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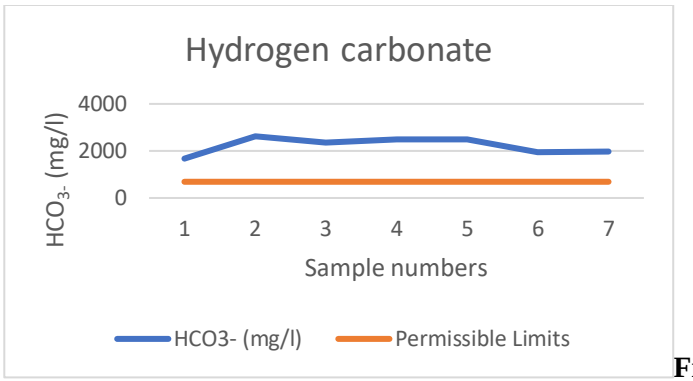

Figure12: Variations in Hydrogen Carbonates

Samples 2,3,4,5 indicate a high increase in Hydrogen carbonate in the landfill areas of Mavallipura and Mittaganahalli. HCO3 even if it's useful to humans if present in water, can be hazardous after allowable limits.

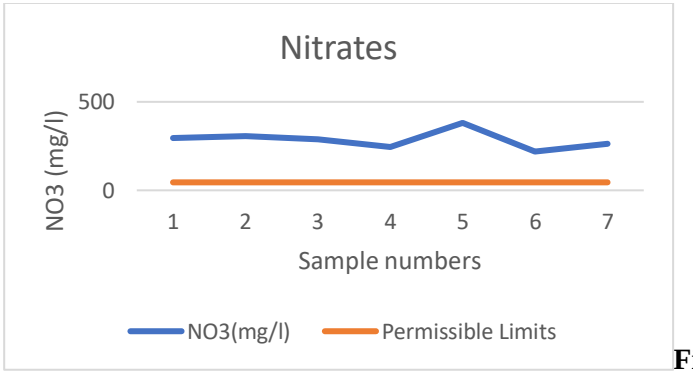

Figure13: Variations in Nitrates

Elevated concentrations of nitrates in samples 1,5 is seen, and proper management is required in areas where other samples are collected. Nitrates present in water can cause colossal effects on infants, causing an eminent ailment known as a blue baby syndrome.

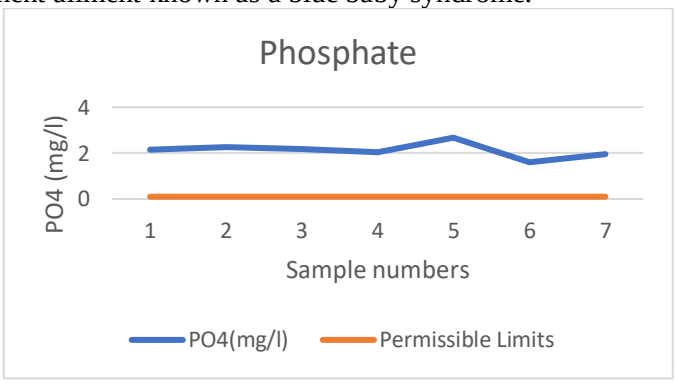

Figure14: Variations in Phosphate

The graph shows that all samples have an increase in PO4 content of water. Proper management can reduce its concentration and can reduce the hazards of PO4 on water bodies.

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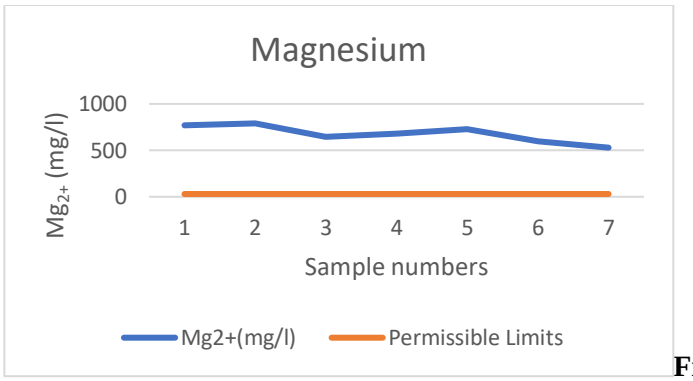

Figure15: Variations in Magnesium

Magnesium percentage in water is at a very lethal level in all the samples. It can cause augmented hardness and can affect the ecosystem if it is not controlled.

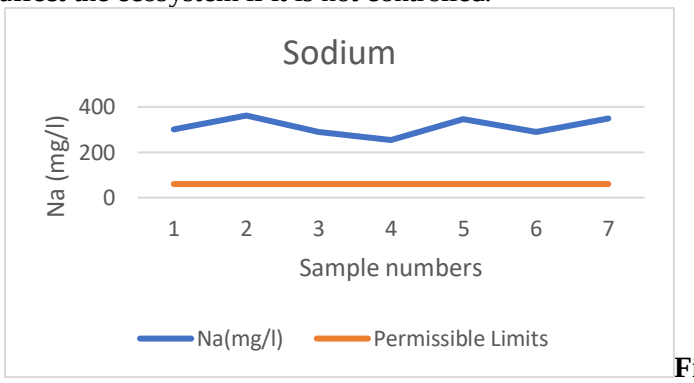

Figure16: Variations in Sodium

Increased concentrations of sodium are seen in samples 2,5,7. Although sodium is a crucial component of the human body, and increased sodium in water can cause heart problems and nausea.

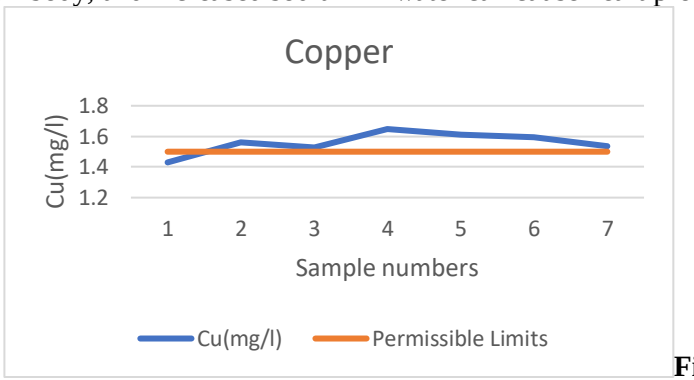

Figure17: Variations in Copper

Copper is in elevated quantities in the samples 4,5 and at a considerable amount in other samples. Although there is an acute increase in its amount, proper management of wastes is the current need.

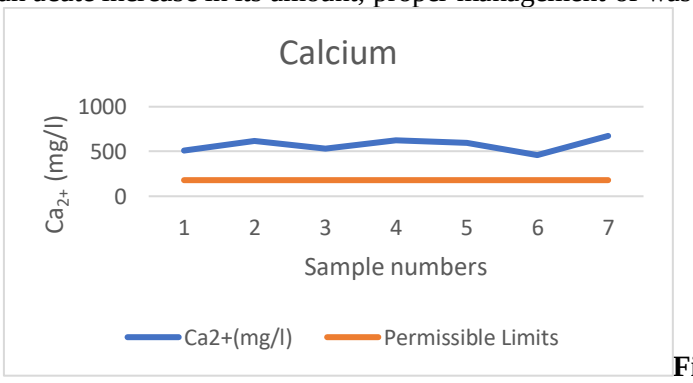

Figure18: Variations in Calcium

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Calcium concentration is at an increased levelin all the samples of landfill sites. It can cause hardness of water and can make it intricate to wash, clean substances using it.

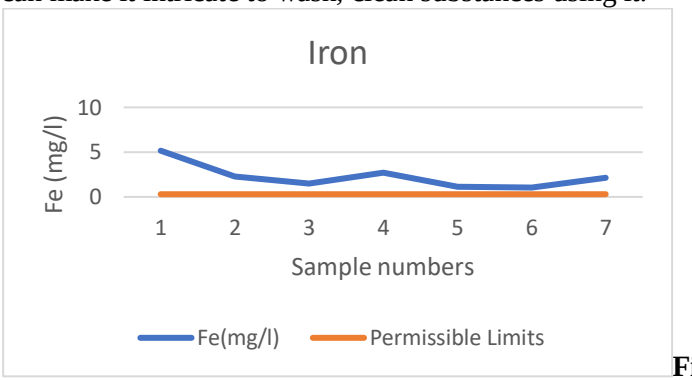

Figure19: Variations in Iron

Samples 1,4,7 showed an increased percentage of Iron in water. Although it will not harm humans when present in water, it can lead to stains in utensils, which are arduous to remove.

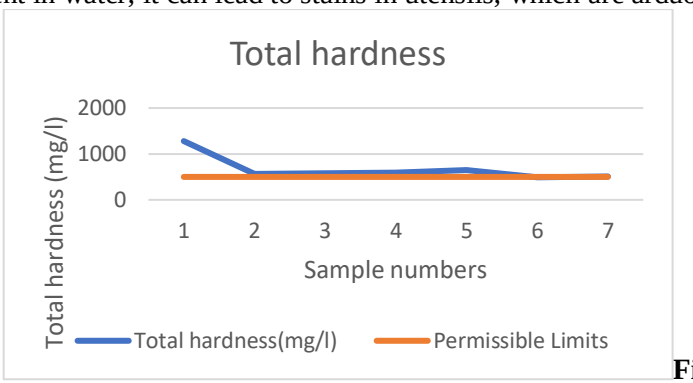

Figure20: Variations in Total hardness

The hardness of water is very high in sample 1, and proper management of waste is needed in other areas to reduce hardness.

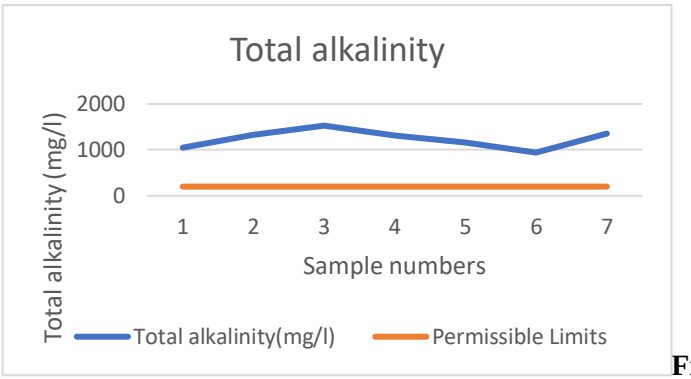

Figure21: Variations in Total alkalinity

Alkalinity is very high in all the samples, and it can be hazardous to aquatic life. Higher alkaline water can reduce pH changes in water.

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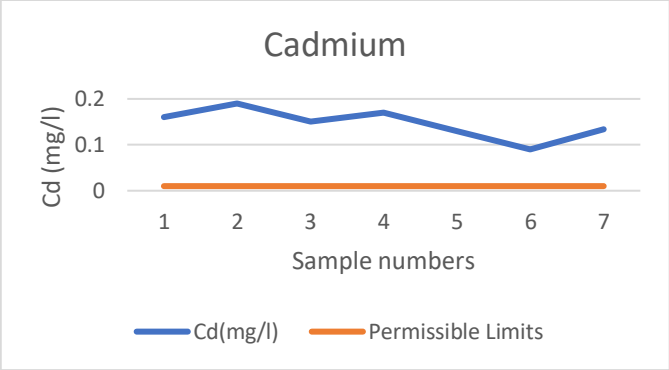

Figure22: Variations in Cadmium

Samples have a very high composition of cadmium, showing that there is less segregation of E-waste during the management of solid wastes. Cadmium at high levels can cause liver and kidney problems.

Results

Samples 1,2,3 collected from the Mavallipura landfill site indicate higher values in water parameters compared to BIS standard limits. Although the Mavallipura site is closed for many years, the effects of water contamination due to improper waste management is seen till date. pH, turbidity, COD, lead, nickel, hydrogen carbonate, nitrates, PO4, magnesium, sodium, calcium, and alkalinity parameters are immensely high above the permissible limits and causing hazardous surroundings to people. Even after the closure of the landfill site, measures to be taken till wastes are properly decomposed or treated. Mittaganahalli is a recently opened site in Yelahanka after the closure of Bellahalli site. Samples 4,5 from this landfill site shows augmented values of pH, turbidity, TDS, BOD, Electrical Conductivity, lead, nickel, hydrogen carbonate, nitrates, magnesium, sodium, calcium and alkalinity above BIS standards. This shows the management of solid waste is not done correctly in a new site, and measures and actions must be taken to reduce the effects of these on nature. Bellahalli site was closed recently and although waste carrying trucks seem to utilize this site and dump wastes. Parameters such as BOD, COD, Electrical conductivity, lead, nickel, nitrates, PO4, sodium, calcium, and alkalinity are elevated beyond standard limits as shown by the above tests. Waste management is one of important aspect should be well organized by BBMP and should not allow any harm to nature.

Discussion

Samples show a massive increase in levels of hazardous parameters in water. This can harm the surroundings, humans, and other organisms in its vicinity. These wastes are composed of toxic materials that are hazardous to soil and even to the groundwater in the surroundings of the landfill. When wastes decompose by the action of microbes, it produces methane and other toxic gases which, if properly treated and released to the ecosystem, cause no harm. Even after treatment, if noxious gases are removed, the foul smell remains. These issues cause people to resist the selection of landfill sites near their locality and close existing ones. Proper disposal and management of solid waste can be done by taking suitable measures such as Segregation of wastes based on respective categories, recognizing dishonest waste collection yards which are profit-based instead of environment friendly. This can decrease the amount of solid waste carried to landfill sites, and segregated wastes can be disposed of by suitable methods.

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