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BEYOND BYTES: AN EVALUATION OF THE TECH'S ECOLOGICAL IMPACT

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ABSTRACT

This paper critically examines the environmental repercussions of modern technology and its unmonitored growth. Technology being an inevitable component in the present world, its creation and development have led to irrevocable damages. The paper tries to throw light onto the key areas of concern, beginning with electronic waste (e-waste) dumping, which is escalating globally, then following up to pollution in its various forms. Improper disposal methods have its immediate causation which needs attentive care and monitoring. Further, the study delves into energy consumption and mining, both of which are intensive and environmentally degrading processes involved in the life span of 'electronic species'. The unsustainable extraction of rare earth elements and metals exacerbates deforestation, water pollution, and ecosystem imbalance. Despite existing legal frameworks like India's E-Waste (Management) Rules, 2022 and the Energy Conservation Act, weak implementation still causes extreme worry despite the successful drafting. The paper also highlights the need for stronger monitoring authorities, public awareness campaigns, and community involvement to mitigate environmental harm. Technology, while a key enabler for achieving Sustainable Development Goals (SDGs) such as clean water,

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innovation, and healthcare, must be balanced with environmental stewardship.

KEYWORDS: Electronic Waste (E-Waste, Environmental Pollution, Sustainable Technology, Energy Consumption, Environmental Regulation

INTRODUCTION:

Technology is the contemporary inevitability that cannot be eliminated from the face of the Earth, anytime soon, for its eminent qualities. It has transformed the lives of every being for the contributions it had offered so far and has been offering for the easier and fuller existence of human beings. This capacity makes it an attractive innovation which is needed by the people for the entirety of their lives. But, merely having such features, doesn't mean that it causes no impact as in the negative font in the lives of the people. It causes an unhealthy impact on the environment, for its existence seems to be endangered. It had to have some considerations regarding its impactful characteristics, but it just seems to avoid that proposition. Environment being the core of the worldly sustenance is on the verge of degradation due to the technology. The essay will be categorising some consequence enhancing arenas which are to be administered properly and some other lacunae prevailing in those areas for its proper removal through adequate steps, which would also be highlighted therein.

1. **Dumping**

   Dumping is one of the most recurring problems of the herd. As the technological products are increasing day by day, even in size and complexity, the problem in its disposal becomes a huge issue. Even if there is a possibility of recycling and reusing component parts, it becomes a difficulty as the new and highly advanced products seem to have their own parts which would only be compatible with their own brand of products, which often make these components useless once it gets damaged, when their validity expires, or when the system changes. Thus,

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the problem of disposing of them occurs, and it leads to large-scale dumping. As per 20th March 2024, the world's generation of wastes which are electronically created are rising five times faster than documented electronic waste recycling.[2] In 2022, a record of 62 million tonnes of electronic waste (e-waste) was generated globally with only 22.3% as properly documented, according to the report of the United Nations Institute for Training and Research (UNITAR).[3] This aggravates the problem to an extent where the

e-components would be filling up the land leading to an unmanageable problem of land pollution and since its not degradable, it affects the soil as well. As soon as they are dumped into a large area, also known as a landfill, they are left to soak into the ground, which would not happen and years would pass on. So far, only 17.4% of the e-waste is properly collected and recycled suggesting that the majority is dumped without any consideration for the environment. Moreover, India in 2025 produced 2.2 metric tonnes of e-waste, making it the third-largest global generator of e-waste, after China and the United States. A majority of them has been recycled, leading to the release of toxic fumes into the air and water, affecting the health of many. It has discarded almost 1.7 million tonnes as per the reports in 2024, and almost 95% of the e-waste produced is mostly dumped or burned.[4][5]

This requires proper monitoring of the authorities onto the dumping and recycling procedure of e-waste. Even if there are rules in the country for proper

[2] R. Khattak, *International E-Waste Day 2024: The Environmental Impact of E-Waste*, Earth.Org (Oct. 14, 2024), https://earth.org/environmental-impact-of-e-waste/.

[3] *Global E-Waste Monitor 2024: Electronic Waste Rising Five Times Faster than Documented E-Waste Recycling*, United Nations Institute for Training and Research (Mar. 20, 2024), https://unitar.org/about/news-stories/press/global-e-waste-monitor-2024-electronic-waste-rising-five-times-faster-documented-e-waste-recycling.

[4] *E-Waste: From Toxic to Green (India)*, United Nations Framework Convention on Climate Change, https://unfccc.int/climate-action/momentum-for-change/lighthouse-activities/e-waste-from-toxic-to-green (last visited Mar. 30, 2025).

[5] Sudheer Kumar Shukla, *The Cost of Convenience: Health Hazards as a Side Effect of Using Digital Tools*, The Hindu (Nov. 14, 2023), https://www.thehindu.com/sci-tech/health/the-cost-of-convenience-health-hazards-as-a-side-effect-of-using-digital-tools/article70116984.ece.

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management of e-waste disposal [E-Waste (Management) Rules, 2022], that needs to be strengthened with stricter guidelines for implementation.[6]

2. Soil Poisoning

Another issue, which is central to the topic, is related to soil contamination, which can be referred to as soil poisoning due to its severity. Soil has already been contaminated by certain chemicals induced through the intensive use of chemical fertilisers and pesticides for large and (nowadays) small-scale farming, which reduces the natural features of the soil, such as self-replenishment, purification, preventing soil erosion and other natural and manmade (nature-related) disasters. Just like the kerosene which further leads to the combustion of the current ongoing flame, the technological dumping creates and further exacerbates the situation of soil contamination. Since the components parts are made of chemicals and metals such as copper, aluminium, steel, etc., these are harmful due to the fact that they contain harmful chemicals (non-metals) like mercury, cadmium and lead, which can cause several diseases.[7] They can get mixed with elements in the soil, mainly water (water present in soil), soil, air, leading to the causation of environmental and atmospheric problems. It can also lead to the death of several living organisms in the atmosphere through their food chains. These harmful elements can get exposed to these organisms, leading to the disruption of the food chain and causing a distorted consequence to the environmental stability.

This similarly, requires the strengthening of monitoring on the part of the entrusted authorities and stiffening the hold of law on the supervision of e-waste dumping so that there would be deterrence. Even if the minimisation of the concentration of the harmful substance used in the manufacture of electrical and

[6] Nivedita Chaudhary, *Electronic Waste in India: A Study of Penal Issues*, Winter Issue 2018, Indian Law Institute L. Rev., https://ili.ac.in/pdf/env.pdf.
[7] Chaudhary, **supra** note 2.

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electronics equipment and their components or consumables or parts or spares has been mentioned in the Chapter VII of E-Waste (Management) Rules, 2022, stricter implementation is further required.

3. Air Pollution

Since the disposal of e-waste is mostly through disposing of it plainly in sight or in a landfill, everyone doesn't have the predicament to know its exact disheartening doings. Such a kind of situation never pressures a citizen to struggle against such wilful disregard or defilation, unless the masses get a hold of the unpleasant results. This mainly happens in the case where the pollutants are burned, thinking that they are mainly plastic wrapped around small, insignificant chemicals, which can be discarded without any proper procedure or any difficulty. Since these metals comprises of harmful chemicals, these in burning can produce dangerous fumes containing harmful noxious gases or harmful breathing agents.[8] These toxic fumes are the primary responsible actors in the production of breathing issues and, to an extent, lung problems in human beings, which are of a serious character. When coming to the environmental impacts, these fumes can cause air pollution. They can change the air quality to the worst level and seriously impact the existing air quality. They can be, as mentioned before, a carrier for many cardiovascular diseases. Moreover, over time, this contaminated air from the burning of e-waste can affect air, water and soil quality, since plants for their photosynthesis depend on water and air as such. On top of all these issues, these gases add to the greenhouse emissions, resulting in an increase in the overall temperature or global warming. The factories that produce these parts are also to blame for their faulty disposal

[8] **Linda Di Gianvittorio**, *The Environmental Impact of E-Waste & Electronics*, iPOINT-SYSTEMS BLOG (Aug. 14, 2024), https://go.ipoint-systems.com/blog/e-waste-dilemma-the-environmental-impact-of-electronics (last visited Mar. 30, 2025).

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mechanisms and improper burning. These all add to the problems caused to the environments through these actors.

These issues can, to an extent, be solved through active mechanisms for the proper destruction of these e-wastes without contaminating the environment. Systems that destroy certain parts and things without adding any fumes to the environment have to be researched and invented, so that these companies can use these things, and certain areas designated for the disposal and combustion of those wastes have to be started, so that normal people can bring out their non-degradable e-wastes to these areas for their discharge. Even though the E-Waste (Management) Rules, 2022, which is an amendment to the Environment (Protection) Act, 1986, has been doing its duty amiably, the problem always lies in the proper implementation.[9]

4. **Water Pollution**

Since the e-waste doesn't have any exceptions regarding the problem-causing, it affects water too. The chemicals contaminate water, leading to affect the aquatic ecosystem. The death of many aquatic organisms is the most obvious result of this wrongdoing. The careless disposal has this cruel effect.

5. **Overseeing**

According to the Chapter VIII (Miscellaneous), rule 24 (Verification and Audit) of E-Waste (Management) Rules, 2022, The Central Pollution Control Board by itself or through a designated agency, shall verify compliance of the rules mentioned therein by the set of people who are to comply with the rules and provisions. In case of non-compliance, appropriate actions can be taken as per rule 22. Also, as per rule 25, a steering committee has to be constituted as such for the overseeing of the overall implementation of the mentioned rules in the act.[10] The overseeing

[9] Di Gianvittorio, *supra* note 5.

[10] **E-Waste (Management) Rules, 2022**, Gazette of India, ch. VII, r. 24 (India), https://egazette.nic.in (last visited Mar. 30, 2025).

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authority should impose stricter penalties including the cancellation of the license, and in the case of grievous polluting activities due to negligence, they should be given imprisonment for a few days or fines.

The overseeing authorities so far have been doing their duty in accordance with the prescribed rules and regulations, but the lack of stricter implementations has paved the way for the increase in the dumping that further facilitates several environmental problems. Thus, it necessitates the need for a stronger overseeing authority.

6. Awareness

One of the stronger reasons for the continuance of the problems relating to technology,

e-waste and environment, is the lack of awareness on the part of common citizens. Every single person isn't properly technically gifted and does not share the same type of intellect to understand the contents of technological equipment. Thus, they require different modes of understanding for the better contemplation and calculation of the consequences. As already mentioned before in this article, the lack of knowledge about the problems of the dumping and other negligent uses of technology is the primary reason for the exacerbation and further aggravation of the current scenario, which is already at its worst. People have to be taught about all situations and what actions on their part can lead to severe problems for the environment, which in turn affects them and their offspring. They have to be provided with proper awareness, and educating them on this issue is the priority. They ought to be supplied with adequate information regarding the causes and effects of any minor acts on their parts that would otherwise have serious consequences for the people as a whole. Mostly, as in the case mentioned before, common people think that the equipments are just plastic wrapped items with any minor chemicals or metals, which are insignificant to cause any major issues to the environment is the basics. Such a lack of significant

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know-how on the part of people is the reason for the start of any kind of act that would have serious repercussions thereafter. Therefore, the primary initiative should be the conduction of an awareness campaign on a large or small scale for the people, informing them about the hazards of the e-waste dumping, burning or any other improper modes of disposal. It will minimise the number of unknowing disposals and their effects to an extent. Community outreach programmes are a good initiative. We can, of course, look up to a multi-pronged programme for achieving this objective which revolves not only around classes, community outreach programmes and campaigns, but also through workshops at schools, personality development classes at schools and universities, engaging with local stakeholders, offering engaged presence for such initiatives for the cause, etc., which can be a great kickstart for such changes.

Such campaigns and classes can be conducted by the local self-government through empowering them through the act itself to conduct such initiatives to minimise the degradation inducing effects and to educate the masses for a proper and safe tomorrow.

7. Energy Succumbing

E-waste generation and its multifaceted impacts on each of the resources are not only the disastrous impact technology has on us. The manufacturing of technological products requires a vast number of natural resources for the energy for the purpose of their production. The production of various technological equipment requires a vast amount of energy and raw materials, which will lead to severe environmental problems. The manufacturing processes aren't sustainable enough to contribute minimal environmental concerns to nature. It consumes the existing energy in it for the sake of its growth in the world.

The energy consumption of the IT (Information Technology) sector is significant due to the fact that its sophisticated units, such as data centres, alone require 70 billion kWh of electricity. Electricity, as is known, is created from water, so the

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more electricity, the more water is used.[11] Moreover, extracting, refining and integrating certain materials into these technologies requires energy. Mining for these metals and chemicals often leads to environmental degradation, including water and soil pollution. Therefore, every single step requires abundant energy and natural resources. Running of machines, overseeing the procedure for their proper continuance, requires monitoring devices, which all further need electricity. Producing a single smartphone, for instance, requires water, roughly estimated at around 12,760 litres, inclusive of all the stages from mining to the completion of manufacturing. [12]

Since all these processes lead to the significant draining of energy and will lead to the exhaustion of natural resources, proper supervision and assurance are very much mandated. In India, we have the Energy Conservation Act of 2001 and the subsequent Energy Conservation (Amendment) Bill, 2022, which governs the energy consumption field and looks over the efficiency in Manufacturing, by making sure they comply with the rules, regulations and standards set by the Bureau of Energy Efficiency (BEE). The scope of the engaging area of the BEE should be widened, since they are the ones who are responsible for setting the standards and drafting guidelines. Also, each and every state government should take a keen interest in the promotion, maintenance and conservation of energy and aim at reducing the energy consumption by the manufacturing agencies of technology. Even if they are doing their mandated job properly, the enthusiasm doesn't necessarily mitigate the unwarranted energy consumption. The penalties provision should be strengthened and upheld correctly for the violations.

8. Mining

Mining is an essential process involved in the manufacture of technological equipment, including smartphones, computers, etc. Aluminium, copper and iron

[11] GreenMatch, *Is Technology Bad for the Environment? Statistics, Trends, and Facts* (May 8, 2024), https://www.greenmatch.co.uk/blog/technology-environmental-impact (last visited Mar. 31, 2025).
[12] Ibid.

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are essentially required for wiring, circuitry, etc.[13] There are some earth elements that are really rare, which are mandatory for the production of magnets, LEDs and other components used in electronics.[14] Thus, mining is the excavation of the main ingredients or raw materials for technological gadgets. Mining in any form is harmful to the environment. It emits harmful gases as well as high-decibel sounds to nature, making it difficult for the organisms including human beings to thrive. Moreover, it makes the soil deranged or disabled further for it to grow vegetation. It makes the soil and the surrounding area useless; it drains of its inherent quality. All these effects are just the overview. The mining operations are conducted in such a way that these are carried out without having an in-depth concern for the other organisms and the earth.

The mining practice is not sustainable now. There is a growing need for the adoption of sustainable practices of mining and for the reduction of any harmful impacts of these operations on the environment. The technology can be used for such practices, which is actually an advantage due to the existence of technology. Sound and fume-reducing mining operations could be carried out with the help of appropriate devices that cater to such conditions.

In the year 2016-17, over 96,000 cases of illegal mining, which are not in adherence with the provisions of The Mines and Minerals (Development and Regulation) Act, 1957 (MMDR) Act, or Mines and Minerals (Development and Regulation) Amendment Act,2023 has been carried out. Maharashtra reported the highest number of incidents with 31,173, followed by Madhya Pradesh with 13,880 cases. In January 2024, a tragic incident took place in the district of Dima Hasao in Assam, where at least nine miners were trapped in a flooded coal mine. This incident occurred because the operation was illegal, not in compliance with the act. These statistics indicate the stricter implementation of the said act with

[13] National Research Council, Overview of Technology and Mining, in EVOLUTIONARY AND REVOLUTIONARY TECHNOLOGIES FOR MINING ch. 3 (Nat'l Acads. Press 2002), https://nap.nationalacademies.org/read/10318/chapter/4 (last visited Mar. 31, 2025).
[14] Ibid.

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higher penalties, safety measures and its assurances and adherence protocols, disobeying which should attract severe punishments.

9. SDG Goals And Technology

Sustainable Development Goals (SDGs) are to be achieved by the nations for the Sustainable Development of the world. They are not legally binding, but the countries are to establish national frameworks for achieving them. Sustainable Development states that the world we are enjoying today belongs to the future generations too, so we should use the available resources in such a manner that they won't be exhausted for the successors. Technology is a requisite for achieving certain sustainable development goals.

SDG 9 talks about the area of Industry, Innovation and Infrastructure. Obviously, technology is required for the process of industrialisation, fostering innovation and building resilient infrastructure.

SDG 17 talks about the partnership for the goals. The goal itself emphasises the importance of technology in strengthening partnerships through knowledge sharing.

SDG 6 talks about clean water and sanitation. Through the medium of technology, the availability of clean water and proper facilities for sanitation can be ensured.

SDG 3 talks about good health and well-being. Technology can help improve the existing health care systems and the available modes of disease control mechanisms.

These all indicate the outstanding role of technology in the achievement of SDG goals. Technology is thus crucial for the overall development of the existing systems for the achievement of sustainable development.

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CONCLUSION:

Technology has infiltrated into each and every sphere in the life of an individual where its help is necessary for the completion of a task. But the lingers, is it dangerous where it is not required? Yes, it is.

Unsupervised use of it can result in the contamination and destruction of the existing natural features, which are irreversible. Therefore, the strengthening of the existing rules and regulations, which would make it difficult for the lawbreakers to break the rules. It should coerce them beyond any means to follow the standards set by the appropriate authorities, which is very much needed for the sake of the proper existence of the world.

The world has given each organism many materials and things to thrive on. The true spirit of being a human being lies in respecting nature and striking a balance between what has been created by man and what has been created for man.