A PRELIMINARY ENVIRONMENTAL STUDIES REPORT
ON

"Environment Awareness"

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THIRD YEAR OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE ENGINEERING

SUBMITTED BY

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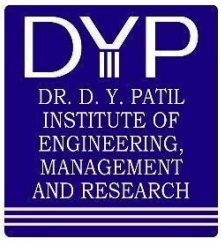

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CERTIFICATE

This is to certify that the **Environmental Studies** report entitles

"Environment Awareness"

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is a Bonafide student of this institute and the work has been carried out by them under the supervision of **Dr Atul Kolhe** and it is approved for the partial fulfillment of the requirement of Savitribai Phule Pune University, for the award of the Third Year degree of Artificial Intelligence and Data Science.

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ANIL DUDHE
(T.E. AI & DS ENGG.)

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1. Introduction

1.1 Environment and its importance, definition and Types:

Def:

Environment is used to describe the circumstances or surroundings in which a system, community, ororganism function. It includes both living (biotic) and non-living (abiotic) things in our environment.The environment is essential for the survival of all species, including humans, and for supporting life on Earth. It can be summed up as all the factors, both natural and man-made, in a specific location that offer the circumstances and resources for life and have an impact on the development, growth, and general well-being of living things.

Importance:

1] Sustaining Life: The environment provides essential resources such as air, water, food, and shelter that arevital for the survival of all living organisms.

2] Biodiversity: A healthy environment promotes biodiversity, which is the variety of life on Earth. Biodiversityis crucial for ecosystem stability, resilience, and adaptability.

3] Climate Regulation: The environment helps regulate climate patterns, which in turn influence weather and other natural processes. Human activities can significantly impact climate, leading to climate change and its associated challenges.

4] Economic Value: Many industries, such as agriculture, forestry, fisheries, and tourism, rely on a healthyenvironment for their economic activities and livelihoods.

5] Cultural and Aesthetic Value: The environment also holds cultural and aesthetic significance, contributingto the identity and well-being of societies and individuals.

6] Human Health: The quality of the environment can directly impact human health through factors like air andwater quality, exposure to pollutants, and access to green spaces.

7] Resource Availability: Natural resources, including minerals, fossil fuels, and renewable resources like windand solar energy, are derived from the environment and are essential for human development.

Types:

1] Natural Environment: This includes the untouched or minimally disturbed environments like forests, oceans,deserts, and wildlife habitats. These ecosystems are largely shaped by natural processes and are home to a diverse range of species.

2] Built Environment: The built environment consists of human-made structures and infrastructure, such as cities, buildings, roads, and transportation networks. Urban and industrial areas are examples of the built environment.

3] Social Environment: This refers to the social and cultural aspects of the surroundings, including institutions, communities, and social relationships. It plays a critical role in shaping human behavior and well-being.

4] Global Environment: The global environment encompasses the entire Earth and includes transboundary issueslike climate change, international conservation efforts, and global ecosystems.

5] Microenvironment: A microenvironment is a smaller, localized environment that may have unique characteristics. For example, the microenvironment within a pond or a leaf on a tree.

6] Man-made Environment: This environment is largely influenced and modified by human activities. It includes urban areas, industrial sites, and agricultural landscapes.

7]Virtual Environment: With the advent of technology, virtual environments have become significant.

1.2Effect of environmental pollution on Plants, Non-living things:

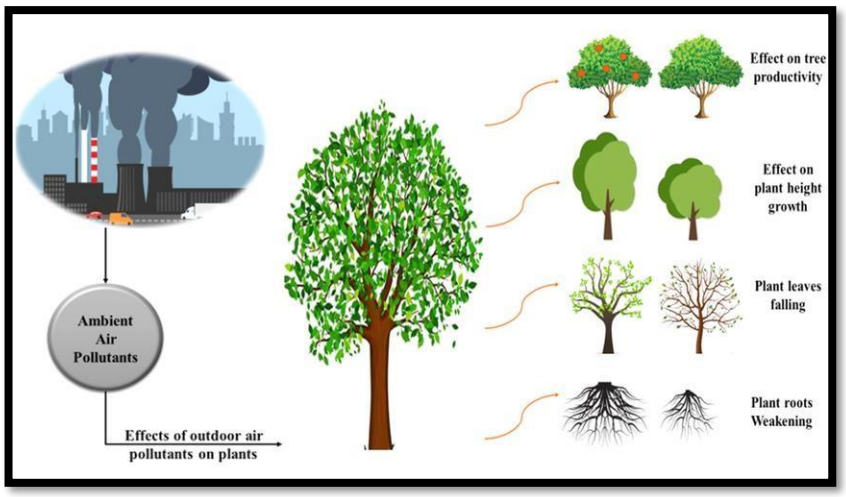

Figure 1.1 Effects of environmental pollution on plants

Effect of Environmental Pollution on Plants:

1] Air Pollution:

Particulate Matter: Airborne pollutants like dust, soot, and fine particles can block the stomata of plant leaves, reducing their ability to photosynthesize and exchange gases.
Chemical Pollutants: Gaseous pollutants like sulfur dioxide (SO2) and nitrogen oxides (NOx) can harm plants by damaging leaves, inhibiting photosynthesis, and altering soil chemistry.

2] Water Pollution:

Contaminated Water Sources: Polluted water can lead to the contamination of soil and groundwater, negatively impacting plant growth and nutrient uptake.
Heavy Metals: The presence of heavy metals, such as lead, cadmium, and mercury, in water can be absorbed by plants and accumulate in their tissues, making them toxic to both plants and organisms higher up the food chain.

3] Soil Pollution:

Chemical Contaminants: Pollutants in the soil, such as pesticides, industrial chemicals, and heavy metals, can directly harm plant roots, disrupt soil microorganisms, and reduce soil fertility.
Soil pH Changes: Acid rain, caused by air pollution, can alter soil pH, making it too acidic for many plant species to thrive.

4] Climate Change:

Global Warming: Elevated carbon dioxide (CO2) levels and increased temperatures due to pollution can affect plant growth patterns, disrupt flowering and fruiting, and shift plant distribution and migration.

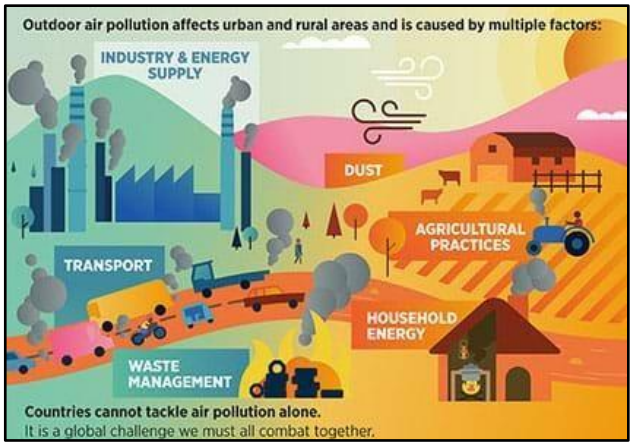

Figure 1.2 Effects of environmental pollution on non-living things

1] Air Pollution:

Buildings and Infrastructure: Air pollution, particularly in urban areas, can corrode and erode buildings, structures, and monuments made of stone, concrete, metal, and other materials.
Atmospheric Changes: Pollutants like ozone can deteriorate synthetic materials, including plastics and rubber, reducing their lifespan.

2] Water Pollution:

Water Bodies: Polluted water can cause the deterioration of aquatic ecosystems, leading to fish kills and the degradation of water bodies.
Pipes and Infrastructure: Water pollution can also corrode and damage pipes and water distribution infrastructure.

3] Soil Pollution:

Infrastructure Foundations: Contaminated soil can weaken the foundations of buildings and roads, leading to structural damage.
Contaminated Sites: Polluted soil at industrial and waste disposal sites can render these areas unsuitable for development or use.

4] Climate Change:

Extreme Weather Events: Climate change resulting from pollution can lead to more frequent and severe natural disasters like hurricanes, floods, and wildfires, causing significant damage to property and infrastructure.

2. Water Pollution

2.1 Definition:

Water pollution is the term used to describe the contaminating of natural bodies of water, such as rivers, lakes, oceans, groundwater, and even drinking water sources. Chemicals, germs, waste products, and other substances can be among the contaminants that render water dangerous and unfit for its intended use, including drinking, swimming, fishing, or supporting aquatic ecosystems. The environment, human health, and general quality of life can all be negatively impacted by water contamination. It is a serious environmental issue that needs workto be done to prevent and lessen its effects.

Sources:

Water pollution can originate from various sources, both natural and human-made. The main sources of water pollution include:

1. Industrial Discharges: Industries release a wide range of pollutants into water bodies. These may include heavy metals, chemicals, solvents, and toxic substances. Effluents from factories and manufacturing processes can contaminate nearby water sources.
2. Agricultural Runoff: Agricultural activities contribute to water pollution through the runoff of fertilizers, pesticides, herbicides, and animal waste. These contaminants can enter rivers and lakes, leading to nutrient imbalances and algal blooms.
3. Municipal Wastewater: Sewage and wastewater from households, businesses, and municipal treatment plants contain organic matter, nutrients, and pathogens. Inadequate treatment or sewage system failures can release untreated or partially treated wastewater into water bodies.
4. Mining Operations: Mining activities can introduce heavy metals and other minerals into nearby rivers and streams. Acid mine drainage is a significant issue, causing water bodies to become highly acidic and laden with heavy metals.
5. Construction Sites: Construction activities can result in sediment runoff, which can cloud water and disrupt aquatic ecosystems. Construction sites may also introduce pollutants like cement and chemicals into waterways.
6. Stormwater Runoff: Urban areas generate stormwater runoff containing pollutants from roads, rooftops, and parking lots. This runoff can carry oil, heavy metals, and other contaminants into local water bodies.
7. Oil Spills: Accidental or deliberate oil spills from ships, pipelines, and oil rigs can have devastating effects on marine environments. Oil can coat aquatic life and destroy habitats.
8. Landfills and Waste Sites: Poorly managed landfills can release leachate, a liquid formed as rainwater percolates through waste, containing harmful chemicals into groundwater and nearby water bodies.
9. Illegal Dumping: The illegal disposal of hazardous waste, chemicals, and trash into rivers, streams, or other water bodies is a significant source of pollution.
10. Atmospheric Deposition: Pollutants from the atmosphere, such as acid rain, can deposit into bodies of water, leading to changes in water chemistry and negatively affecting aquatic life.
11. Agricultural Livestock: Large-scale animal farming operations can produce vast amounts of manure, which, if not properly managed, can leach into groundwater and nearby water bodies.
12. Aquaculture: Fish farms and aquaculture operations can introduce antibiotics, nutrients, and disease-causing agents into surrounding water bodies.

2.2Types of wastewater-Domestic and industrial wastewater:

Figure 2.1. Types of waste-water

1. **Domestic Wastewater**:

1.1 Household Wastewater: This is wastewater generated by residential households and typically includes water from toilets, sinks, showers, bathtubs, and washing machines. It is often referred to as "sewage."

1.2 Commercial Wastewater: Commercial establishments such as restaurants, hotels, and offices generate wastewater similar in composition to household wastewater. However, commercial wastewater may contain additional pollutants, like food waste and cleaning chemicals.

1.3 Municipal Wastewater: This is the combined wastewater from both residential and commercial sources within a municipality. It is collected and treated by municipal wastewater treatment plants before being discharged or reused.

1.4 Stormwater Runoff: While not strictly domestic wastewater, stormwater runoff from streets, parking lots, and urban areas is sometimes managed alongside domestic wastewater due to their common treatment facilities.

2. **Industrial Wastewater**:

2.1 Process Wastewater: Generated by industrial processes, this wastewater can vary significantly in composition depending on the industry. It may contain chemicals, heavy metals, organic pollutants, and other contaminants specific to the production processes involved.

2.2 Cooling Water: Industrial facilities often use water for cooling purposes. The resulting cooling water, when discharged, can carry heat and may contain pollutants like suspended solids.

2.3 Agricultural Wastewater: Agricultural operations, such as farms and ranches, generate wastewater primarily from activities like irrigation, livestock operations, and the use of fertilizers and pesticides. This wastewater can contain nutrients, organic matter, and agricultural chemicals.

2.4 Mining Wastewater: Mining activities produce wastewater with high levels of suspended solids, heavy metals, and toxic substances. Acid mine drainage is a severe form of mining wastewater pollution.

2.5 Food and Beverage Wastewater: This category includes wastewater generated by food processing plants, breweries, wineries, and other food and beverage manufacturing facilities. It contains organic matter, nutrients, and often high-strength organic pollutants.

2.6 Chemical and Pharmaceutical Wastewater: The chemical and pharmaceutical industries generate wastewater with a wide range of chemical compounds, some of which can be hazardous to the environment.

3. Air and Noise pollution

3.1 Air pollution:

Figure 3.1. Air Pollution

Definition:

Air pollution can cause cardiovascular and respiratory diseases as well as cancer, and is the leading environmental cause of premature death in the EU. Certain substances, such as arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons, are human genotoxic carcinogens, and there is no identifiable threshold below which they do not pose a risk. Air pollution also negatively impacts the quality of water and soil and damages ecosystems through eutrophication (excess nitrogen pollution) and acid rain. Agriculture and forests, as well as material and buildings, are therefore affected. Air pollution has many sources, but mainly stems from industry, transport, energy production and agriculture. While air pollution in Europe has generally decreased in recent decades, the EU's 2013 long-term objective, namely to achieve levels of air quality that do not have significant negative impacts on human health and the environment, still remains to be attained. Air quality standards are often not complied with, especially in urban areas (air pollution 'hotspots') – which is where the majority of Europeans live. The most problematic pollutants today are fine particles, nitrogen dioxide and ground-level ozone.

Sources/ Causes of Air pollution:

1. Combustion Processes:

1.1. Vehicular Emissions: Exhaust gases from cars, trucks, and other vehicles release pollutants like carbon monoxide (CO), nitrogen oxides (NOx), hydrocarbons, and particulate matter.

1.2. Industrial Emissions: Factories and power plants burning fossil fuels, such as coal and oil, emit sulfur dioxide (SO2), nitrogen oxides, and particulate matter.

2. Agricultural Activities:

2.1. Ammonia: Livestock waste and the use of ammonia-based fertilizers release ammonia into the air.

2.2. Methane: Enteric fermentation in ruminant animals (e.g., cows) produces methane, a potent greenhouse gas.

3. Natural Sources:

3.1. Volcanic Activity: Volcanic eruptions release gases and particulate matter into the atmosphere.

3.2. Forest Fires: Wildfires emit smoke, particulate matter, and gases.

3.3. Dust and Pollen: Wind and natural processes can release dust and pollen into the air, impacting air quality.

4. Indoor Sources:

4.1. Tobacco Smoke: Smoking indoors produces harmful indoor air pollutants.

4.2. Household Products: Cleaning products, paints, and building materials can release volatile organic compounds (VOCs) indoors.

5. Chemical Reactions:

5.1. Ground-Level Ozone: It forms when nitrogen oxides and volatile organic compounds in the presence of sunlight react. Ozone at ground level is a harmful air pollutant.

5.2. Photochemical Smog: A complex mixture of pollutants, including ozone, forms in urban areas under specific weather conditions.

6. Waste Disposal:

6.1. Open Burning: Burning of waste materials in open dumps or landfills can release toxins and particulate matter into the air.

6.2. Incineration: The incineration of waste materials can produce air pollutants, including dioxins and furans.

7. Hazardous Chemical Releases:

7.1. Industrial Accidents: Accidental releases from chemical plants or hazardous material storage facilities can lead to air pollution episodes.

8. Construction and Demolition:

8.1. Dust and Particulates: Construction and demolition activities can generate airborne dust and particulate matter.

8.2. Emission from Ships and Aircraft: Transportation sources, such as ships and airplanes, release pollutants into the air, especially near ports and airports.

9. Global Sources:

9.1. Greenhouse Gas Emissions: The burning of fossil fuels and deforestation contribute to the accumulation of greenhouse gases like carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), leading to global climate-change.

3.2. Atmospheric layers, Effects on human:

Atmospheric Layers:

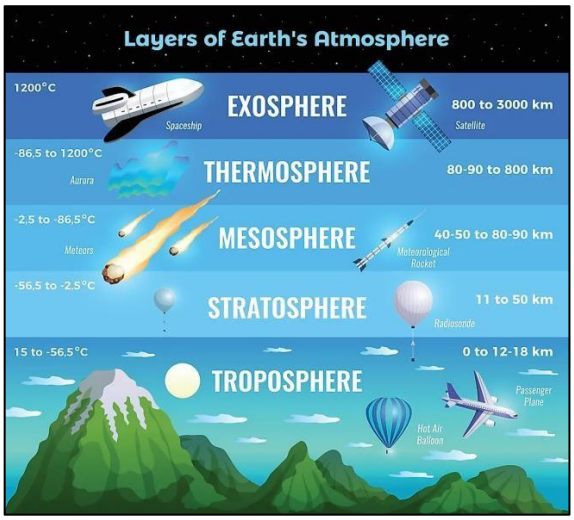

Figure: 3.2. Atmospheric Layers

1.Troposphere:
This is the lowest layer, extending from the Earth's surface up to an average altitude of about 8-15 kilometers (5-9 miles).
It contains the air we breathe and is where weather events occur, including clouds, precipitation, and storms.
The troposphere has a significant impact on human life as it directly influences weather and air quality.

2.Stratosphere:
The stratosphere extends from the tropopause (the boundary with the troposphere) to about 50 kilometers (31 miles) above the Earth's surface.
It contains the ozone layer, which absorbs and scatters ultraviolet (UV) radiation from the Sun.
The ozone layer in the stratosphere helps protect human health by reducing exposure to harmful UV radiation, which can cause skin cancer, cataracts, and other health issues.

3.Mesosphere:
The mesosphere extends from the stratopause to about 85 kilometers (53 miles) above the Earth's surface.
It is the coldest layer of the atmosphere and is where meteoroids burn up upon entering the Earth's atmosphere.

4.Thermosphere:
The thermosphere extends from the mesopause to about 600 kilometers (375 miles) above the Earth's surface.
This layer experiences extremely high temperatures, but because the air density is so low, it would not feel hot to a human in direct contact with the air.
The International Space Station orbits in the lower thermosphere.

5.Exosphere:
The exosphere is the outermost layer of the Earth's atmosphere and gradually merges with the vacuum of space.
It consists of very sparse gas molecules and is where satellites and space debris orbit the Earth.

Effects on Humans:

1. Air Quality in the Troposphere: The troposphere is the layer closest to the Earth's surface and contains the air we breathe. Human health can be significantly affected by pollutants and particulate matter in the troposphere, leading to respiratory problems and other health issues.
2. Protection from UV Radiation: The presence of the ozone layer in the stratosphere shields humans from harmful ultraviolet (UV) radiation. Depletion of the ozone layer, due to human-made substances like chlorofluorocarbons (CFCs), increases the risk of skin cancer, cataracts, and other UV-related health problems.
3. Temperature Extremes: While humans do not inhabit the upper layers of the atmosphere, extreme temperatures in the mesosphere and thermosphere can impact space travel and satellite operations.
4. Space Exploration: The thermosphere and exosphere are critical to space exploration and satellite communication. Understanding these layers is essential for safe space travel and maintaining global communication networks.

3.3 Noise Pollution: Definition of Noise Pollution:

Definition:

The presence of excessive, disruptive, or unpleasant noise that interferes with routine activities and disturbs the surrounding acoustic environment is referred to as noise pollution, also known as sound pollution. It refers to obnoxious or damaging environmental sound, which is frequently identified by its volume, duration, frequency, or erratic patterns. Noise pollution can negatively affect human health, happiness, and quality of life. In some situations, it can also have an impact on animal behavior and communication, as well as ecosystem dynamics. Traffic, industrial processes, construction work, aircraft, and loud music are a few common contributors of noise pollution. Regulations, noise barriers, soundproofing techniques, and public awareness campaigns are frequently used in efforts to limit noise pollution.

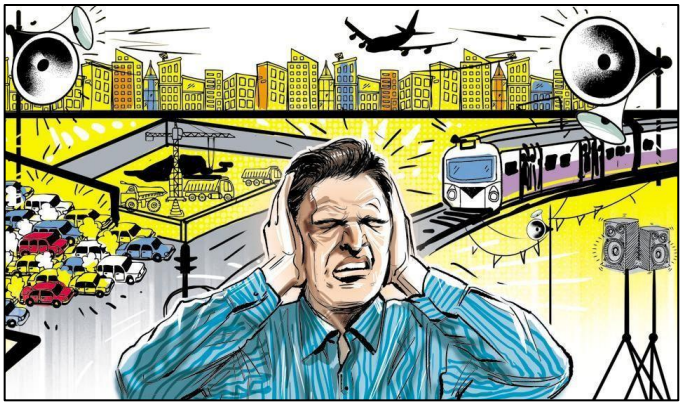

Figure: 3.3. Noise pollution

3.4 Types of Noise Pollution:

1. Road Traffic Noise:

In the city, the main sources of traffic noise are the motors and exhaust system of autos, smaller trucks, buses, and motorcycles. This type of noise can be augmented by narrow streets and tall buildings, which produce a canyon in which traffic noise reverberates.

2. Air Craft Noise:

Now-a-days, the problem of low flying military aircraft has added a new dimension to community annoyance, as the nation seeks to improve its napof the- earth aircraft operations over national parks, wilderness areas, and other areas previously unaffected by aircraft noise has claimed national attention over recent years.

3. Noise from railroads:

The noise from locomotive engines, horns and whistles, and switching and shunting operation in rail yards can impact neighboring communities and railroad workers. For example, rail car retarders can produce a high frequency, high level screech that can reach peak levels of 120 dB at a distance of 100 feet, which translates to levels as high as 138, or 140 dB at the railroad worker's ear.

4. Traffic & Mobility

Petrol and diesel engines of cars, ships, trains and other vehicles emit pollutants such as carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM), sulfur dioxide (SO2), and volatile organic compounds (VOCs). Friction from tires and brake wear also create primary – i.e. direct – particulate matter emissions

4. E-waste management and green computing

4.1 E-waste management:

Definition of E-waste:

Electronic waste, also shortened to "e-waste," is the term used to describe abandoned or obsolete electronic equipment and gadgets, as well as their components, that are no longer in use and need to be disposed of, recycled, or managed properly. Old computers, cell phones, televisions, appliances, and electronic accessories are just a few examples of the enormous variety of electronic and electrical products that are included in e-waste. For the sake of both the environment and human health, these devices must be properly disposed of and recycled because they may contain harmful substances including heavy metals and chemicals. Due to the accelerating speed of technical innovation and the rise in usage of electronic devices, e-waste is a major global concern. In order to lessen environmental contamination and recover valuable resources from these abandoned products, proper treatment and recycling of e-waste are crucial.

Figure:4.1. E-waste (Electronic waste)

Sources of E-waste:

The major sources of e-waste include:

1. **Households**: Consumers regularly replace or upgrade electronic devices, such as smartphones, laptops, tablets, televisions, and home appliances, leading to a significant amount of e-waste generated by households.
2. **Businesses**: Commercial and industrial sectors contribute to e-waste through the disposal of outdated office equipment, computers, servers, printers, copiers, and other electronic devices.
3. **Government and Institutions**: Government agencies and institutions, including schools, universities, and research organizations, generate e-waste from the replacement and disposal of computer equipment and other electronics.
4. **Healthcare Facilities**: Hospitals, clinics, and medical research facilities generate e-waste due to the replacement of medical equipment, diagnostic devices, and computers.
5. **Manufacturers and Retailers**: Electronic manufacturers and retailers contribute to e-waste through the disposal of unsold or returned products, as well as obsolete demonstration models.
6. **Telecommunication Companies**: The telecommunications industry generates e-waste when upgrading network infrastructure, decommissioning cell towers, or replacing communication equipment.
7. **Agriculture**: The agricultural sector uses electronic equipment for various purposes, including GPS systems, drones, and data collection devices.
8. **Government and Military**: Government and military agencies generate e-waste from the replacement and

decommissioning of electronic systems and communication equipment.

9. **Construction and Demolition**: The construction and demolition industries generate e-waste from the disposal of electronic tools, security systems, and construction equipment.
10. **Public Infrastructure**: Traffic lights, surveillance cameras, and other electronic components of public infrastructure can become sources of e-waste when they are replaced or upgraded.
11. **Consumer Electronics Retailers**: Retailers selling consumer electronics generate e-waste from unsold or returned products, as well as obsolete store display units.
12. **Entertainment and Media**: The entertainment industry, including movie theaters, concert venues, and production companies, generates e-waste from the replacement of audiovisual equipment.
13. **Transportation**: The transportation industry, including airlines, railways, and public transit, generates e-waste from the replacement of electronic systems used for navigation, communication, and control.
14. **Data Centers**: Data centers and server farms generate e-waste when decommissioning or upgrading servers, storage devices, and networking equipment.

4.2 Types of E-waste:

Some common types of e-waste include:

1. Information Technology (IT) Equipment:

- Computers: Desktops, laptops, and servers.
- Monitors: Cathode-ray tube (CRT) monitors and flat-panel displays.
- Peripherals: Keyboards, mice, and external storage devices.
- Printers and Scanners: Laser and inkjet printers, as well as multifunction devices.

2. Networking Equipment: Routers, switches, and modems.

- Data Storage Devices: Hard drives, optical drives, and solid-state drives.
- Mobile Devices: Smartphones, tablets, and e-readers.

3. Consumer Electronics:

- Televisions: CRT TVs, LED/LCD TVs, plasma TVs, and projection TVs.
- Audio Equipment: Stereos, speakers, headphones, and amplifiers.
- Video Players: DVD players, Blu-ray players, and VCRs.
- Cameras: Digital cameras, camcorders, and surveillance cameras.
- Gaming Consoles: Video game systems and accessories.

4. Home Appliances:

- Refrigerators and Freezers.
- Washing Machines and Dryers.
- Air Conditioners and Heaters.
- Microwave Ovens.
- Vacuum Cleaners.
- Dishwashers.

5. Office Equipment:

- Photocopiers.
- Fax Machines.

6. Communication Equipment:

- Landline Phones.

- Cordless Phones.
- Answering Machines.
- Mobile Phone Accessories.

7. Lighting Equipment:
- Compact Fluorescent Lamps (CFLs).
- Fluorescent Tubes.
- LED Lamps.

8. Industrial Equipment:
- Control and Monitoring Systems.
- Laboratory Instruments.
- Electronic Scales.

9. Medical Devices:
- Diagnostic Equipment.
- Monitoring Devices.
- Imaging Equipment.
- Laboratory Instruments.
- Renewable Energy Equipment:
- Solar Panels.
- Wind Turbines.
- Inverters and Batteries.
- Electrical Tools and Equipment:
- Power Drills.
- Saws.
- Welding Equipment.
- Other Electronic Devices and Components:
- Cables and Wiring.
- Printed Circuit Boards (PCBs).
- Power Supplies.
- Connectors.
- Electronic Components (e.g., resistors, capacitors).

4.3 Green computing:

Definition:
Green computing, also known as sustainable or eco-friendly computing, refers to the practice of designing, manufacturing, using, and disposing of computer hardware and software in an environmentally responsible and energy-efficient manner. The primary goal of green computing is to reduce the environmental impact of information technology (IT) and minimize the use of non-renewable resources, energy consumption, and electronic waste generation.

Figure:4.2 Benefits of Green computing.

4.4 Necessity, Environmental benefits:

Green computing, or sustainable computing, is necessary and offers several environmental benefits due tothe increasing environmental concerns and the growing impact of the information technology (IT) industry on the environment. Here are the reasons for its necessity and its associated environmental benefits

Necessity:

1. Energy Consumption: The IT industry is a significant consumer of electricity, contributing to a substantial carbon footprint. Sustainable computing is necessary to reduce this energy consumption.
2. Resource Depletion: The manufacturing of IT equipment relies on the use of non-renewable resources. Sustainable computing aims to reduce this reliance and conserve valuable resources.
3. Electronic Waste: Rapid technological advancements lead to the disposal of large quantities of electronic waste, which can be hazardous and problematic if not managed properly. Sustainable computing focuses on reducing e-waste and promoting responsible disposal and recycling.
4. Climate Change: The IT industry's energy consumption and greenhouse gas emissions contribute to climate change. Sustainable computing plays a crucial role in mitigating these effects.
5. Regulatory Compliance: Governments and regulatory bodies are increasingly imposing environmental regulations on IT operations. Complying with these regulations is essential to avoid legal issues.

Environmental Benefits:

1. Reduced Energy Consumption: Sustainable computing practices, such as energy-efficient hardware and power management, lead to reduced electricity consumption, lowering greenhouse gas emissions and energy bills.
2. Resource Conservation: By using renewable and recyclable materials, sustainable computing conserves valuable resources and reduces the environmental impact of IT equipment manufacturing.
3. E-Waste Reduction: The refurbishment and responsible disposal of electronic waste minimize the accumulation of hazardous materials in landfills and promote resource recovery through recycling.
4. Lower Carbon Footprint: Energy-efficient data centers and IT equipment reduce carbon emissions, helping combat climate change.
5. Improved Air Quality: Reduced energy consumption leads to lower emissions from power plants, resulting in improved air quality and reduced health risks for humans.
6. Longer Equipment Lifespan: Green computing practices often lead to longer equipment lifespans, reducing the frequency of replacements and e-waste generation.

5.References

[1] B. Frank, Artificial intelligence-enabled environmental sustainability of products:marketing benefits and their variation by consumer, location, and product types, J Clean Prod 285 (2021), 125242.

[2] K. Jha, A. Doshi, P. Patel, M. Shah, A comprehensive review on automation in agriculture using artificial intelligence, Artif Intell Agric 2 (2019) 1–12.

[3] D.L. Poole, A.K. Mackworth, R. Goebel, Computational Intelligence: A Logical Approach, 1, Oxford University Press, New York, 1998.

[4] Z. Wang, R.S. Srinivasan, A review of artificial intelligence based building energy use prediction: contrasting the capabilities of single and ensemble prediction models, Renew Sustain Energy Rev 75 (2017) 796–808.

[5] R. Nishant, M. Kennedy, J. Corbett, Artificial intelligence for sustainability:challenges, opportunities, and a research agenda, Int. J. Inf. Manage. 53 (2020),102104.

[6] Y. Duan, J.S. Edwards, Y.K. Dwivedi, Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda, Int. J. Inf. Manage.48 (2019) 63–71.

[7] J. Morelli, Environmental sustainability: a definition for environmental professionals, J Environ Sustain 1 (1) (2011) 2.

[8] T.O. Olawumi, D.W.M. Chan, A scientometric review of global research on sustainability and sustainable development, J Clean Prod 183 (2018) 231–250.

[9] S.W.S WCED, World commission on environment and development, Our common Futur 17 (1) (1987) 1–91.

[10] S. Leahy, Climate study warns of vanishing safety window—Here's why, Natl Geogr (2019) https//www Natl com/environment/2019/03/climate-change-model-warns-of- difficult-future.