Evaluation of Environmental Pollution and Waste Management Strategies on the Ecosystem

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Abstract – This article presents a discussion on environmental pollution, and waste management strategies. Whether it has a direct or indirect link, everything in the immediate ecosystem has some kind of bearing on the natural world. Pollution in the environment is caused by more than just humans; other organisms and natural disasters (such as quakes and volcanic eruptions) contribute, as well. Although environmental degradation has always been an issue, it has recently become a major danger to human civilization. The main question that surfaced when we were preparing our scientific research include: "What is the impact of the waste management on the environment?" There is widespread concern about environmental pollution today because of the many ways in which we are exposed to it on a daily basis, including through the food we eat, air we breathe, radiation we are exposed to, and water we drink. The depletion of natural resources, the loss of animal and plant species, and disruptions in global ecosystems and biochemical processes are further indicators of the effects of environmental concerns. The research findings suggest that waste management likely has serious consequences for the natural world.

Keywords – Environmental Pollution, Environmental Degradation, Waste Management, Waste Management Strategy.

I. INTRODUCTION

Due to rising populations and rising levels of industrial production, the landfill that collect our garbage are multiplying at an alarming rate, further degrading our planet. Large amounts of trash are generated daily in urban regions as well as rural and agricultural ones. For instance, every 10 million tons of oily products and 500 billion tons of industrial waste products are disposed into waterways. There are approximately a billion tons of ash and aerosols released into the atmosphere annually from industrial facilities and transportation. Garbage gets piled up at the dump for years. Seventy percent of all trash ends up in landfills. Waste bio-decomposition causes environmental damage via its biochemical processes. Insects, mice, and rats, all of which make a significant contribution to disease widespread, thrive on the municipal garbage that contaminates the vegetation and soil, surface water, ground water, and air in enormous amounts. The health of future generations is at risk because of this new predicament. As a result, proper waste management becomes an issue for ecological security. Industrial waste, municipal solid trash, agricultural waste, electronic waste, medical waste, and other mixed waste products are only few examples of the wide variety of waste types.

Chemical, biological, and nuclear waste all have serious pollution effects and may have devastating effects on the environment and humans. In the 90s of the 20^{th} centuries, the average solid waste output per person was between 100 and 330 kilograms in the European Union, 414 kilograms in North America, and 720 kilograms in Asia. Waste generation and waste generation per person are both on the rise around the globe [1]. The main issue is that instead of being recycled or composted, this trash ends up in massive landfills near cities, where it may pollute the air, water, and ground. If solid

wastes are not effectively handled, it may have negative consequences on public health, air quality, odours, and hazardous gas emissions.

According to the data in **Fig 1**, 27.3% of the population (9 people) agrees that improper waste management may lead to water contamination. A total of 21.2% (7 people) said that solid wastes may contribute to air pollution, and 18.2% (6 people) said the same about odor pollution. Solid garbage thrown into drainage systems might lead to sewage obstruction, according to the opinions of 12.1% (4 respondents). All respondents agreed that if Langkawi did not have any problems with solid waste, more people would visit. Nevertheless, 6.1% of the respondents (2 people) said that solid waste was a major problem. Sixty-six percent (20 people) said they would dispose of solid wastes in the right areas, while thirty-three percent (10 people) said they would try to cut down on their source consumption to help.

The way in which garbage is handled has real-world repercussions on people's quality of life in their communities. Proper garbage management ensures that residents may live in peace. Dasar Alam Sekitar Negara is a crucial government initiative for trash management [2]. The policy's ultimate goal is to ensure that future generations may always enjoy a healthy, prosperous, and environmentally sound environment. Human activity produces this garbage. Waste management is an important issue for both urban and rural communities in developing nations. Waste is defined by the Akta Kualiti Alam Sekeliling 1974 [3] as any substance that may contribute to environmental contamination, whether it is solid, liquid, or gaseous, and whether it is released, released, or deposited in the environment.

Solids within sewage system or proof of water polluting agents such as solids and silt in industrial waste are not included in the definition of wastes, which includes undesired objects and other waste materials from community activities, agriculture and trade garbage. Nonetheless, the accumulation of trash may be harmful to the ecosystem. Pollutants in the air and water will both increase due to improper garbage disposal. Several of the elements involved in waste management that might have an adverse effect on the environment have contributed to this. Aesthetic degradation is the most readily apparent consequence of solid waste in the environment. The inappropriate burning of garbage poses a greater threat since it pollutes not only the air, but also the water and land underneath. Landfills produce methane and trash fleets are major producers of carbon dioxide and nitrous oxide, therefore these activities all contribute to global warming, as stated in [4].

The issues of environmental contamination and improper garbage disposal will be addressed here. Everything of our material possessions has some kind of indirect or direct link to the natural world. Man isn't the only thing that has an impact on environmental degradation; other animals and natural disasters (earthquakes, volcanic eruptions) do, too. Environmental pollution has been there since the beginning of life on Earth, but it has only recently become a major danger to humanity. This is how the remainder of the paper is structured: Section II focuses on a brief discussion of environmental pollution. This section provides a graphical evaluation of the Mean PM 2.5 levels in many polluted nations globally from 2020 to 2021. Section III introduces the concept of waste management providing statistical evaluations, and a discussion of disposal of solid waste in landfill, industrial waste management, hazardous waste management, biodegradation, and recycling. In Section IV, the strategies of waste management are discussed: waste prevention, recycling and reuse, waste minimization, and biological treatment. The final Section V provides final remarks on environmental pollution and waste management.

II. ENVIRONMENTAL POLLUTION

Climate change, ozone depletion, and desertification are all the outcome of environmental degradation in nations and places where pollution is the worst. The United Nations established the definition that "pollution is exogenous chemical compounds encountered on a suitable site, at the proper time, and in insufficient amounts" [5]. Analysis (conducted in the early 20^{th} century) suggests that the atmosphere and the hydrosphere are the most contaminated regions on Earth. Likewise, the condition of the cosmos in our solar system is cause for grave worry. The fundamental ecological unit, defined by complex variables of living and inanimate nature, must be taken into account if we are to define the idea of the environment. Ecology is the name for this system. Man's effect on the natural world is substantial since he is a thinking entity. Among the population of children aged 0-19 years old, the World Health Organization (WHO) identifies about 25 risk factors to human health, some of which are environmental.

Direct (immediate) and indirect (reaching out to others) synergy both describe possible types of environmental influence from economic and other activity. In terms of the environment, the impacts of pollution are often expressed using the words we've previously mentioned: degradation, destruction, and threat. Pollution has observable consequences on the environment and its inhabitants. There are both immediate and long-term consequences of pollution. Understanding the idea of a working environment and how it relates to the idea of environmental protection might be crucial when discussing environmental management. There's a plethora of motivations for doing this. To begin, the operation is connected to and has significance for the environmental problem because of the working environment's role in the environment. Workplace safety and health laws, as well as other rules in this field, include a number of clauses that shed light on the nature of the connection between the office and the natural world.

Not only is it important to have a firm grasp on the concept of "workplace," but also of phrases like "hazardous materials," "danger," "dangerous phenomena," "risk," and "risk assessment," among others. This legislation establishes what is meant by "work environment," or the conditions, methods, and relationships inside a certain workplace in which work is carried out. Human-caused environmental degradation, including altered energy inputs and radiation levels,

environment pollution's physicochemical and microbiological components may be identified. Physiological and anatomical structure, growth, and metabolism processes at different phases of cellular organization (from microscopic and molecular levels, through populations and individuals, to ecosystems and biocenosis) are affected negatively by pollution.

The average PM2.5 concentration in Bangladesh in 2021 was 76.9 g/m^3 hence making it the most polluted nation in the world. There was over 20 g/m3 higher PM2.5 than the norm in India. Due to a building boom in the nation, Bangladesh's brick industry has mushroomed to the point that thousands of coal-fired kilns are spewing out dangerous pollutants, contributing to the country's already high levels of air pollution. A tiny particle with a diameter of 2.5 micrometers or less is referred to as PM2.5. At high quantities, these airborne contaminants pose a serious threat to human health despite their microscopic size and light weight. Annual mean PM2.5 emissions should be kept below 10 g/m3 according to WHO recommendations. The incineration of solid waste, automobile emissions and industrial boilers are all significant contributors to PM2.5 levels in the environment. Average PM2.5 levels in Delhi were 85 g/m3 in 2021, making it the most contaminated capital city in the world once again. Dhaka, the capital of Bangladesh, came next. Due to COVID-19 shutdowns and limitations, PM2.5 concentrations decreased in numerous cities across the globe in 2020, with levels in Delhi decreasing by almost 15 percent relative to the previous year.

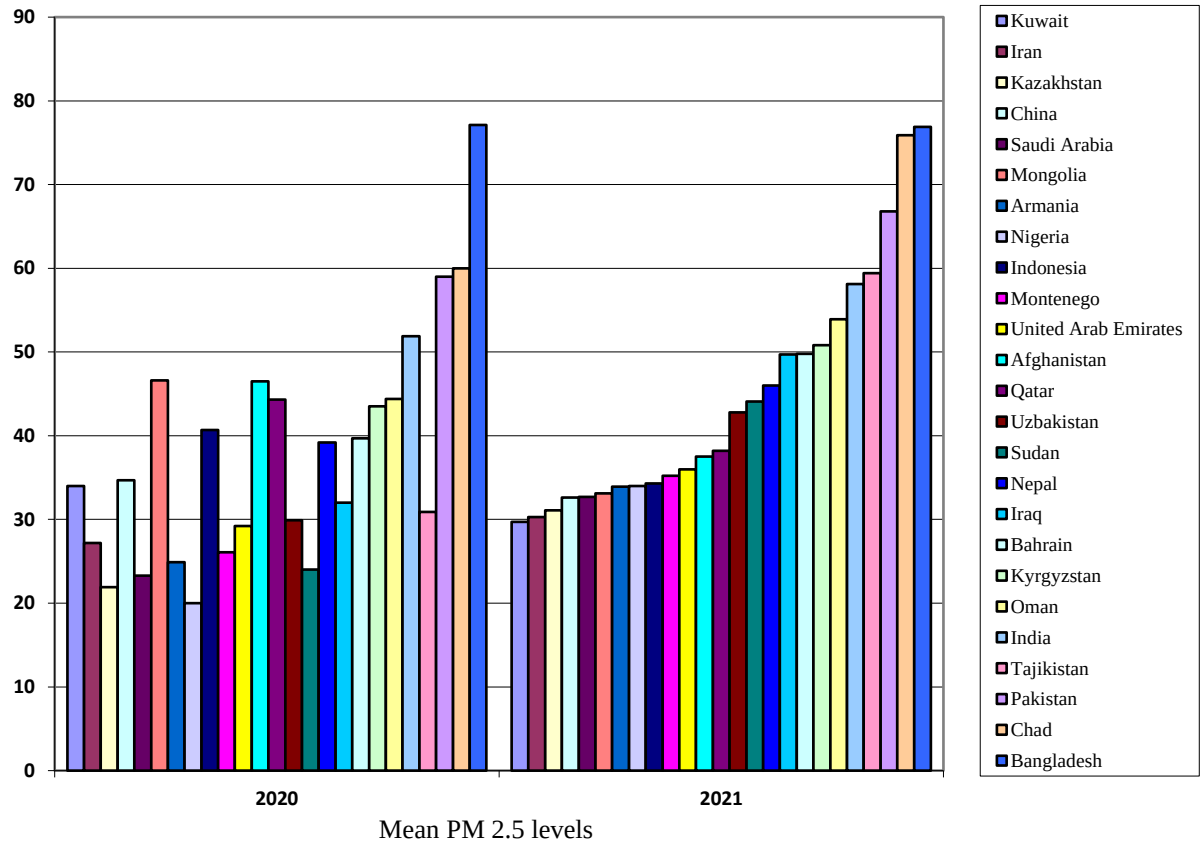

Fig 1. Mean PM 2.5 Levels in Many Polluted Nations Globally From 2020 To 2021

III. WASTE MANAGEMENT

Statistical Evaluations

Every year, humans produce 2 billion tons of municipal trash, and approximately 32% of it is not managed in an environmentally friendly manner. From 0.11 to 4.54 kilos per day, the international mean of wastes generated for every human is approximately 0.73 kg. High-income nations produce 34% of the globe's garbage (680 million ton), even though having approximately 15% of the globe's population. By 2050, the estimated amount of garbage produced worldwide will be 3 billion tons that is more than twice the projected increase in human population during that timeframe. As a whole, more money means more trash, thus it stands to reason that more money would also mean more recycling. The daily per capita waste production is projected to increase by approximately 19% in nations that are categorized as high-income by 2050, but it is projected to rise by approximately 40% or even more in middle- and low-income nations.

The degree of rise in the production of waste relating to an increase in income is more for low-income individuals compared to their counterparts in high-income nations, at least during their initial phases of income development. By 2050, the amount of garbage produced in the world's poorest nations is projected to grow by more than a factor of three. Twenty-three percent of the world's trash is being produced in East Asia and the Pacific, with 6 percent coming from the North Africa and Middle East. By 2050, overall garbage creation is predicted to more than quadruple in Sub-Saharan Africa,

double in the North Africa and Middle East and double in South Asia. More than 50% of garbage is disposed in the open spaces in their continental regions, and the projected expansion in waste has serious consequences for human health, the natural world, and economic development. **Fig 2** provides an illustration of the forecasted waste production (millions of tons per year) based on region.

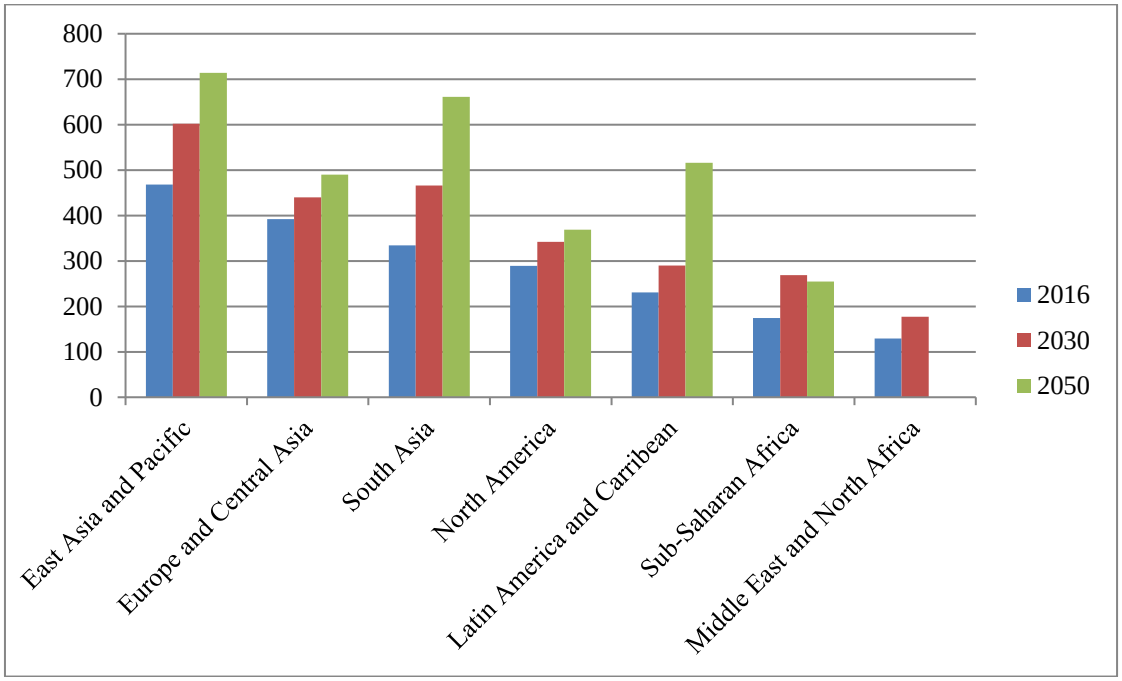

Fig 2. Forecasted Waste Production by Region

Although though garbage collection is essential, rates vary greatly by economic level, with practically universal waste collection available in upper-middle and high-income nations [6]. Around 48% of garbage in different cities gets collected in low-income nations, but that number decreases dramatically to 26% outside of metropolitan areas. As a whole, Europe, Central Asia, and North America gather at least 90% of their garbage, but Sub-Saharan Africa only collects 44%. **Fig 3** shows the rate of waste collection based on the income level of individuals.

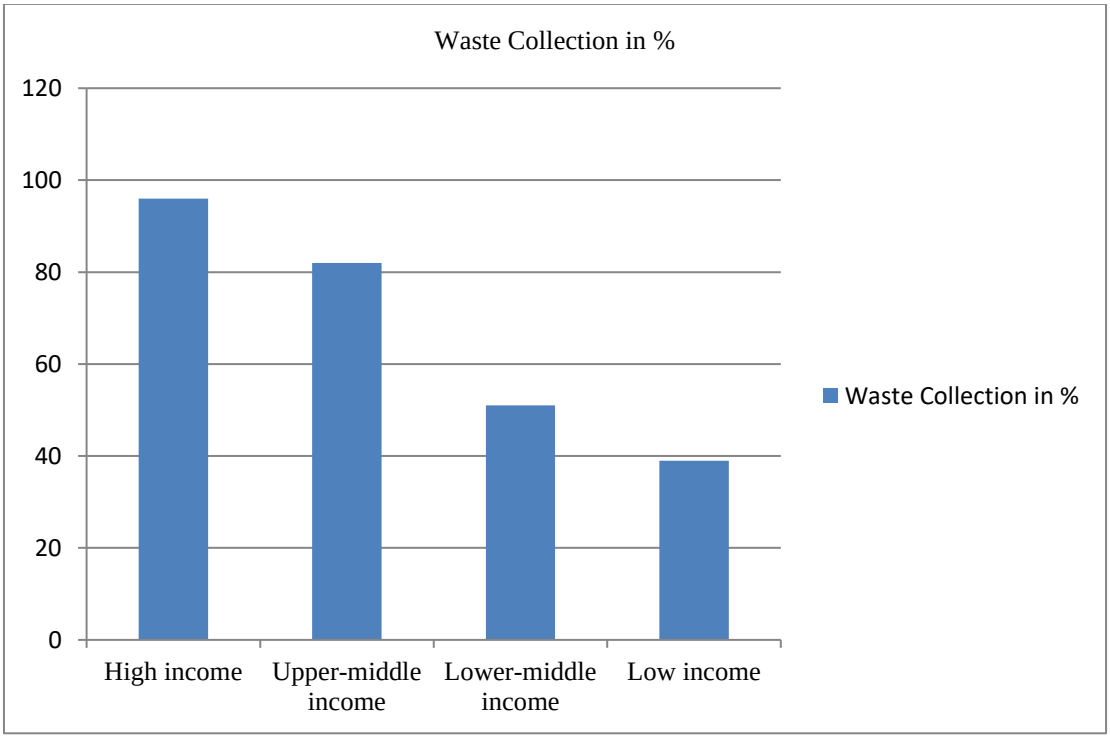

Fig 3. Rate of Waste Collection According to The Level of Income

The content of trash varies by economic level because of the various lifestyle choices people make at those levels. In high-income nations, dry trash such as glass, metals, paper, cardboard, and plastic accounts for approximately 50% of the overall garbage, were green and food waste account for just 32 percent. Food and waste account for approximately 53% of all garbage in low-income countries, whereas green waste accounts for 57%; the proportion of organic waste rises in developing nations. Only 20% of garbage in low-income nations is recyclable. There is not much variation in waste streams among areas, save those that correspond to economic levels. With the exemption of Central Asia, North America, and Europe, which yield larger amounts of dry wastes, all areas create at least half of their trash as organic. **Fig 4** illustrates the composition of global wastes in percentage.

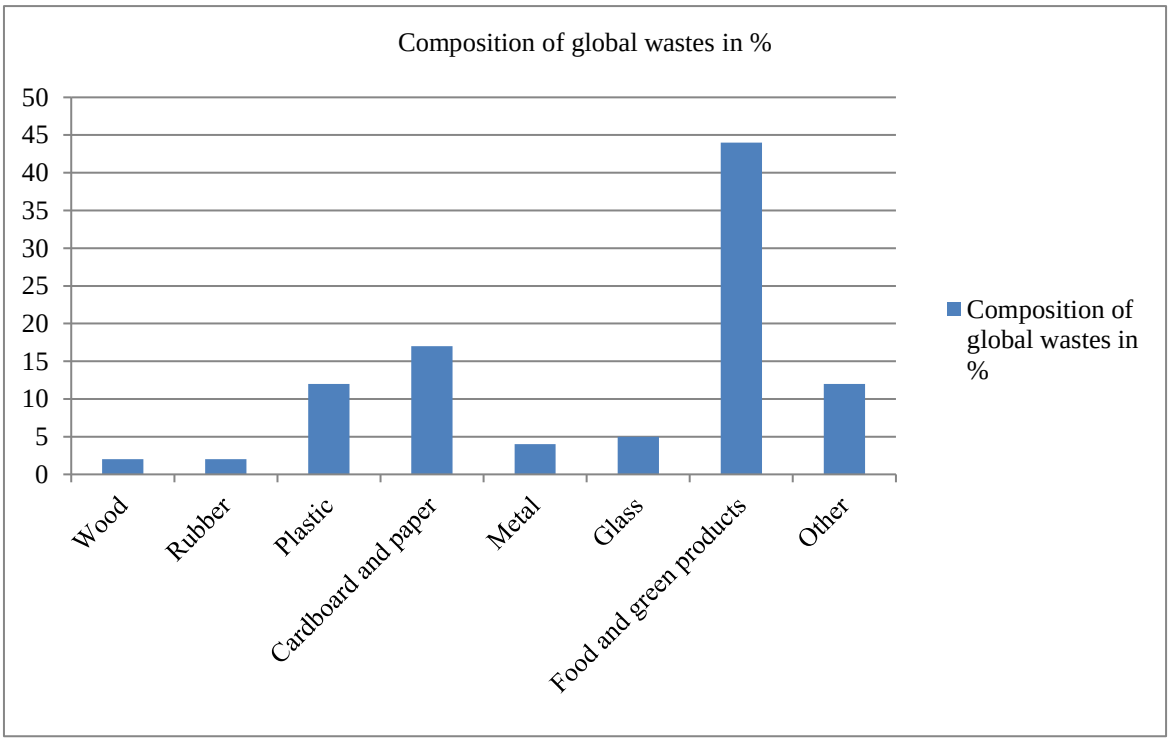

Fig 4. Composition of Global Wastes

Many people wrongly believe that modern technology holds the key to halting the spread of garbage that is now out of control. Technology is hardly a silver bullet and is often just one of several considerations in solid waste management. If a country wants to move away from waste management practices like open dumping, it will have the best chance of doing so if it chooses solutions that are tailored to its own needs and circumstances. Nowadays, most of the landfills are the most typical method of garbage disposal worldwide. Around 37% of trash is being dumped in a landfill, with just 8% going to sanitary dumps that also include landfill gas collecting systems. Around 31% of trash is dumped illegally, 19% is collected for reuse or recycling, and 11% is burned. High- and upper-middle-income nations are the only ones with the resources to provide proper waste disposal or treatment, such as regulated landfills or more strictly managed facilities.

More than ninety-three percent of trash is discarded in low-income nations, whereas only 2% is deposited in high-income nations. Most of the world's garbage is dumped in the open in three places: the North Africa, Middle East, South Asia, and Sub-Saharan Africa. It is no surprise that nations in the upper middle-income range have the greatest rates of trash dumped in landfills (54 percent). In high-income countries, this figure falls to approximately 39%, with 36% of waste being diverted to composting and recycling and about 22% to incineration. Only countries with a higher capacity, limited land usage, and high revenue usage resort to incineration. **Fig 5** illustrates an international disposal and treatment of wastes in percentage.

Solid waste treatment and disposal was responsible for about 5% of worldwide emission of greenhouse gas in 2016, or 1.5 billion tons of carbon dioxide equivalents. This estimate is based on the amount of garbage produced, its composition, and how it is handled. The primary factor in this is the use of landfills and open dumps without landfill gas gathering frameworks for wastes. Approximately 50% of greenhouse gases originated from trashed food. If no transformations are considering in the industry, solid waste emissions are forecasted to increase to approximately 2.40 billion tons of carbon-dioxide-equivalent per annum by 2050.

Almost 70% of global countries have established firms with the mandate for the regulation and creation of policies in the waste management sector and most countries' solid waste management activities are primarily handled at the municipal level. Over 60% of countries have enacted certain solid waste management regulations and laws; however, their level of enforcement tends to vary greatly. Over 70% of waste services are managed directly by local public authorities, with the

federal government only being involved in regulatory monitoring and financial transfers. At least half of all waste management services, including collection, sorting, disposal, and treatment, are issued by governmental agencies, while another 30% are issued through private-public partnerships [7]. The partnership with private sectors for operation and finance are not always the best choice, however, since they often only work under particular circumstances with proper incentive structures and enforcement mechanisms.

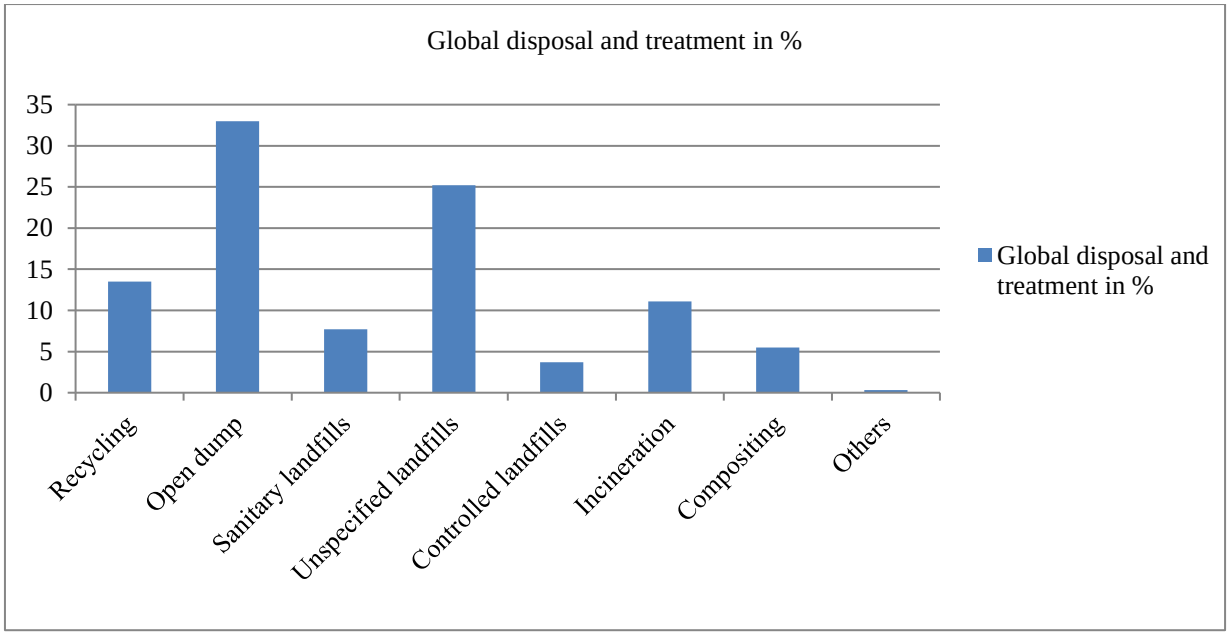

Fig 5. Global Disposal and Treatment of Wastes

Costs associated with maintaining and operating a waste management system are difficult to budget for, and must be considered in advance of any capital expenditures being made. In high-income nations, the whole cost of managing garbage, from collection to transportation to treatment to disposal, may easily top $100 per ton. Although lower-income nations pay less overall on waste operations, at about $35 per tonne and often more, they have a considerably harder time recouping their investment. Management of waste requires a lot of manpower, and only the transportation expenses might add up to $20 - $50 a ton. Recovery of garbage service costs varies greatly depending on household income. User fees average about $36 per annum in countries categorized as low-income and approximately $171 per annum in countries categorized as high-income being the only ones where the payments cover the costs. A user's price structure might be either constant or variable, depending on their circumstances [8]. Usually, national federal subsidies and the private sector make up the other half of the investment expenses for waste systems, with local governments picking up the tab for half.

Disposal of Solid Waste in Landfills

To dispose of garbage, people use landfills. There are a number of different kinds of landfills, distinguished by the way trash is disposed of and the security measures in place to avoid air and water contamination. Putting trash in the open without any kind of containment system pollutes the air and water. Sanitary landfills are constructed to minimize the possibility of solid waste items interacting with the surrounding air. As an alternative to landfills, today's trash is disposed of deep below. Hence, both air pollution and the unwelcome spread of animals are prevented. There are drawbacks to this waste management strategy as seen in **Table 1**,

Table 1. Drawbacks of Disposal of Solid Wastes in Landfill

Groundwater contamination	Groundwater contamination might occur if you choose the improper subterranean landfill.
Low oxygen concentration	There is no oxygen for the garbage to decompose when it is buried and situated in the midst of the nation. It produces biogas, a mixture of hydrocarbons, predominantly methane. When it spreads horizontally, biogas may enter building basements and, when it comes into touch with open flames, burn and explode.
Worsening drooping areas	When trash decomposes, its volume diminishes, causing drooping areas where it is impossible to construct structures and other infrastructure.

Strategies for Controlling and Building Landfill

Three techniques identified in **Table 2** are used for building landfills:

Table 2. Techniques used for Building Landfill	
Holding wastes based in their biological and chemical properties	To prevent the spread of dangerous compounds into the environment, the waste is held on land with the necessary properties and capacity for self-purification. The only thing preventing the contaminating chemical in this situation is land. Land should thus be selected carefully to fulfill certain chemical and biological requirements (such as grain size, clay distribution).
Controlling maximal permeability of contaminants	Restricting, or limiting, the maximal permeability of contaminants from landfills to landfill coating materials, which are water resistant, minimizing the entry of air and surface water and resulting soil contamination; establishing a layer of insulation in the landfill bottom to inhibit water filtration; and launching a draining framework to collect water, which has permeated the top covers. This water is either repurified or returned to the soil.
Concept of restriction	The theory in [9] views a landfill as a form chemical reagent. The current strategy keeps the concept of restriction, but does it in a regulated way to create a managed chemical reactor.

Industrial Waste Management

Technological and scientific endeavors generate vast quantities of trash, yet many of these materials may be recycled and reused. There are a variety of environmental protection concerns that go into the decision to recycle or reuse materials, including the desire to lessen the impact on natural resources like water and soil. To further understand the nature of industrial trash, we may break it down into its component parts: waste wood, scrap, waste plastics, and other industrial wastes.

New technologies are being developed that are good for the environment and are all-encompassing, cutting down on the quantity of primary production. Innovations in non-waste technology should include: - the utilization of closed systems for industrial water supply - the manufacturing of products and daily trashing into new goods - development and manufacturing that prioritizes reuse.

Hazardous Waste Management

The United States Environmental Protection Agency considers any trash that is combustible, corrosive, reactive, or poisonous to be hazardous. Nowadays, hazardous trash is literally everywhere. Approximately 60% of all industrial hazardous waste comes from the chemical industry; 20% comes from the metal industry; 5% comes from the military; 2% comes from the pharmaceutical industry; 1% comes from clinical centers; 1% comes from households and 2% comes from small businesses, according to studies.

Hazardous Veterinary and Medical Waste

Medical-veterinary waste encompasses any and all trash produced by hospitals and vet clinics, regardless of its chemical make-up or point of origin. It's a wide variety of things including trash from the city, germs from a lab, old medicine, unused packaging, and leftovers from the pharmacy. The categories of trash in **Table 3** make up the 14% of medical waste that is considered hazardous:

Table 3. Categories of Trash Making Up Medical Wastes	
Infectious waste	These include those generated by a microbiology lab's instruments, materials, and accessories, which make contact with infectious patients or blood used in surgical operations, hemodialysis, garbage-infested gloves and experimental animals.
Sharp items	Anything that may stab or cut, such as needles, syringes, scalpels, and other sharp items.
Repulsive materials	These features discolored or otherwise unappealing human or animal body parts (for example, those removed following surgery), laboratory animals, or animal anatomy.
Medicines and chemicals	Medicines and chemicals used in the pharmaceutical industry that have either expired or been returned to the original departments where they were taken from are considered pharmaceutical industrial waste.
Discarded chemicals from medical or laboratory	Discarded chemicals from medical or laboratory usage, household cleaning, or disinfection are examples of chemical waste. Black and gray radioactive contaminated tools, supplies, solutions, animal cadavers, and test subjects. Thermometers, blood pressure monitors, and other medical gadgets all contain mercury, lead, and arsenic, among other heavy metals, as a byproduct of their manufacturing.

Biodegradation

Biodegradation and composting have considerable promise for treating organic waste from urban sources. Based on its thermal capacity of approximately 24000 KJ/m^3, biogas produced from processing a single ton of organic wastes could amount to approximately 500 m^3. Bacteria and other forms of biota rely on it to survive. Both the number and variety of

bacteria much exceed that of any other group of microorganisms. Nitrogen fixation is a bacterial process that is essential for life and soil fertility. Food scraps account up a large percentage of MST. Both the density and the humidity are rather high. The method of biodegradation is presented to deal with the waste issue. Biodegradation realization is possible in medium-sized rural and urban settings, particularly on smaller farms and greenhouses. Biodegradation's ultimate products (biogas, water, and organic fertilizer) are environmentally pure, making them useful in both commercial and residential settings. Biodegradation is a common economic technique in many nations, serving several functions including protecting arable land and biodiversity, producing electricity, and getting high-quality organic fertilizer.

Technology Biodegradation of Organic Waste

Due to microorganisms, which are essential to the biosphere's ecological processes because of the large quantities of oxygen they produce via their immense activity, the planet supports life. Biodegradation of organic waste by bacteria has occurred over many years. Humans have learnt to control this process, creating targeted communities of microbes. Knowing the chemical composition of waste components is essential for microbial decomposition of both vegetable and animal matter. The make-up of the trash differs according to the types of food products that are discarded. Organic food waste is mostly "provided" by the food processing sector, agricultural growers, and a few organizations. The following are some of the ways in which industrial garbage and food scraps of animals or plants are used; wastes from other industrial and municipal activities should be collected of in landfills; organic wastes are applied as manure on farmland; domestic animal corpses are buried; industrial waste is discharged into the city's sewage system; waste is disposed of in illegal landfills.

There is no environmental or economic justification for the current practice of disposing of municipal garbage, which accounts for a significant portion of the overall amount of solid waste, via incineration, compaction, or landfill. There are always efficient and low-cost solutions to deal with garbage. The use of biodegradation technology is the answer to these issues. European nations make extensive use of biodegradation in their economic operations. It is a common practice in Western European farms, where it is used to produce both energy and natural fertilizers. Microbial degradation of organic waste is commonplace in Norway and Canada, both in homes and in factories. It may be stated that the biodegradation technique is cost-effective. Fertilizer is a valuable commodity that may be sold to generate revenue from its use.

Recycling

Recycling refers to the process of collecting usable materials and separating them from trash for later use. Repurposing entails gathering discarded goods, sorting them, processing them, and making new products from the resulting raw materials. Recycling refers to the practice of reusing materials rather than discarding them. It is hard to conceive of a fully integrated waste management system without the widespread implementation of recycling in schools. While there are facilities elsewhere that use recycled materials to create new products, no such facilities exist in the United States. Paper service is one of the few places where people may recycle their old paper for cash. Glass recycling depots are nonexistent, leading to the annual waste of thousands of bottles. Strategic goals such as conserving natural resources and lowering pollution levels may be achieved by recycling (all materials come from limited supplies and are obtained from natural sources). Cost-cutting Energy Efficiency Measures (there is no wasted energy during the basic operations, nor during the transportation and subsequent procedures, and surplus energy may be produced by burning non-recyclable materials). Prevention of pollution and degradation of the natural environment involves decomposing garbage and recycled goods.

Materials for Recycling

"Materials may be: - Recyclable (this lessens the damage mining does on the environment) (may be put back into production once recycling has taken place), - non-recyclable (do not belong in the production cycle again, but are instead used to create energy or buried in a manner that does not harm the environment). - Dangerous (materials that might potentially harm people or the environment), Safe (substances that are safe for both people and the planet). It is possible to classify recycling as either "primary" (reuse of materials that have been cleaned and processed several times is one example of recycling) or "secondary" (recycling, whereby recyclables are processed in the traditional manner utilizing cutting-edge tools to maximize efficiency).

Recycling of Plastic Waste

The intrinsic inertia of plastic trash makes it a formidable composting opponent. Reusing old boxes helps cut down on garbage and pollution while also conserving resources and power. Overconsumption of plastic goods and subsequent waste disposal is a major contributor to the problem. There are a variety of methods for recycling plastics, but they all accomplish the same thing. There are seven steps involved in the technical process: First, trash is gathered, and then recyclables are identified and chosen, then milled, then rinsed, then spun, then dried, and finally stored. Another problem arises when plastic trash from homes gets mixed in with the regular garbage. Several containers (of glass, paper, plastic, etc.) are developed to address this issue. This system of collection and classification is widely used in most EU nations. Over 30 million tons of plastic trash is collected in the 21st century's first decade within the United States.

The difficulty in properly discarding this trash highlights the value of finding new uses for it. The average American consumes 86 kilograms of plastic per year, 27 kilograms of which is packaging. Over 80% of Germany's yearly plastic

waste volume is recycled or roughly 800 tons. Although this may seem like a lot, consider that only roughly 200 tons of plastic are recycled in the United Kingdom. There has been a rise in the processing of plastic waste since the year 2000, with each piece of plastic being returned to a landfill. It's an unusable byproduct of processing. Plastics that degrade when exposed to microorganisms are a major research and development focus. They are the so-called "biodegradable" plastics. Biodegradable plastic is not a panacea, and it cannot be used to replace all plastics. In spite of our considerable capabilities, we are not yet doing enough to properly handle plastic trash. It's the treatment of trash whose origin and make-up are already recognized. Processing power is likewise rather low.

Car-Battery Recycling

To put it another way: "Landfills are being used to dump enormous quantities of random trash. The year-round disposal of used batteries takes place in landlls that have not been prepared for such use. This causes serious soil contamination from the battery's lead, acids, and other inorganic elements. It's important to sort out which parts may be recycled ahead of time, recycle those parts, and then properly dispose of the remaining garbage from recycled batteries. Reusing batteries is not a widely adopted practice despite its obvious environmental and financial benefits. Since it is so challenging to make a selection, only a limited number of firms engage in the collection of old batteries from uncontrollable landfills that are widespread and settle all types of waste products. Data shows that we dispose of one-fourth of all batteries produced. Lead is a crucial raw material derived from used batteries.

Recycling of Vehicles at the End of Life

An item of such complexity as an automobile is rare. Steel predominate and cast iron in the construction of the vehicle's many components. Over 80% of a vehicle's mass may be recovered with today's recycling infrastructure. The complexity of auto recycling stems from the wide range of materials used in its construction. The 3% of a vehicle's mass that is glass is not processed in glass factories due to its complicated chemical makeup but is instead chipped and utilized as a concrete component. Motor vehicle fluids, e.g., gasoline, engine oil, transmission fluid, and radiator fluid account for approximately 2% of a vehicle's total mass. Because of their poisonous chemical make-up and unique properties, these fluids provide a considerable challenge throughout the auto recycling process. The five percent of a vehicle's weight that comes from rubber is processed further into industrial applications to generate various items (protective fencing, flooring, and asphalt). "Used vehicle batteries pose a serious hazard to the environment; to mitigate this, it is necessary to move to a system that uses various kinds of filters based on the life cycle of the battery. Carefully and separately handling the car's many components is essential. "Now, two technologies of recycling the automobiles are utilized, each with its own unique approach to separating the various components. The first approach relies on optical separation, whereas the others combine many techniques (such as mulching, gravity, and other unique techniques).

IV. WASTE MANAGEMENT STRATEGY

Workers in the trash business face several dangers over the course of their jobs, including those associated with garbage collection, transportation, storage, and treatment. Waste management refers to the systems put in place and the actions taken by those systems to reduce trash and encourage people to recycle and compost their garbage.

Waste Prevention

Zero waste is the optimum solution for managing garbage. The major purpose of any waste management strategy needs to be geared towards the avoidance of wastes. Wastes could be eliminated and pollution avoided or reduced through the employment of different technologies, which can be employed at any phase of the products' life cycle. Some examples of green manufacturing practices include using less toxic or harmful materials, installing leak detection systems in storage facilities, developing new methods of chemical ozonation to lessen reactions, and implementing water conservation technologies to cut down on the amount of potable water used in production.

Waste Minimization

It is sometimes not possible to completely remove wastes from many different types of operations. Yet, several options exist for controlling garbage production. The term "waste minimization," sometimes known as "source reduction," alludes to a collection of practices based on the production and design of goods and services with the goal of reducing the quantity and/or toxicity of waste produced. Most of the time, these initiatives are launched when researchers discover a pattern or product that is contributing to an already existing waste issue. Repurposing resources, translating to less toxic alternative materials, and transforming design and production parameters are all applicable strategies to minimize industrial wastes. Source reduction and waste minimization have several advantages, such as lowering carbon emissions and toxicity levels in landfill garbage.

Strategies for reducing waste in production are widespread; not only does minimizing the consumption of materials helps to reserve scarce resources, but it also amounts to significant saving in manufacturing-related expenditures. Advancements in shaping packaging not only cut down on the usage of materials, but also on the use of fuels and pollutants that come from transporting goods. Additionally, the weight and bulk of a building might frequently be significantly decreased by employing engineered building materials, which are established using particular advantages

features. Hence, less material may be purchased in bulk, and less can be thrown away during the manufacture of the component.

Toxic waste reduction by product substitution is shown well in the drier cleansing sector. Perc or Trichloroethylene was the selected solvent for drier cleanshing agents for decades. Tetrachloroethylene represents an effectual solvent, but it is also somewhat poisonous [10]. In addition, it is modest to release it into the ecosystem, where its physical features make it significantly challenging to eradicate. Also, the process of degradation generates intermediate sister chemical, which is significantly dangerous to the environment and human health. The dry cleansing business has adapted novel processes and it drastically employing minimally hazardous substitute solutions, such as petroleum-centred compounds, such as environmental and toxicity effect of the chemicals formerly used. Also, carbon dioxide and other innocuous compounds are being integrated into modern technology. Some replacement goods have been accepted in part because of government regulation, but also because of customer desire and other market-based pressures.

Recycling and Reuse

Metals, paper, glass, wood and plastic are just some of the various recyclable materials, which could be salvaged from waste heaps and employed in the manufacturing of new products. Enhanced employed of recycled materials implies that less of raw materials have to be applied for similar purposes. In addition to reducing the need for mining natural resources, recycling also allows for the reuse and recovery of one-disposed products. By transforming earlier-used materials from landfill disposal and incineration, including by minimizing the overall usage of energy and greenhouse gas concentration, which contribute to worldwide climate change, repurposing/reusing has a direct positive effect on the conservation of natural resources, and reducing pollution effects. Recycling also has the ability to provide growth and new employment opportunities for the economy.

Materials such as glass, plastic, paper, steel, aluminium, and wood are typically recycled. Masonry, asphalt, concrete, and reinforcing steel are some of the reusable construction materials. Reusable green materials are typically applied as fertilizer and mulch. Regenerating and refining solvents for future use is a typical practise in various industrial segments, as is the recovery of other byproducts. Acids may be recovered by spray roasting, ion exchange, or crystallization, copper and nickel can be extracted from metal operations, finishing, oils, plasticizers, and fats can be collected from filter media such as clays and activated carbons, and many more examples exist.

On a daily basis, people see different cases of reuse and recycling programs that have been effective. It is not uncommon for recycled materials to play a crucial role in the production process, both as raw materials and as the final product. Recycling is often practiced in a variety of industries, such as the paper and metals industries. Sometimes, the processing of salvaged materials is minimal, if any at all. Instances of this include the production of wood chips from tree trimmings and the use of previously used bricks and other building materials into brand-new buildings. For recycling to be successful, several factors must come into play, including widespread public acceptance and marketing of recycled goods and uses, as well as efficient collecting and processing of recyclables.

Biological Treatment

Disposal of trash with high organic components in landfills is being more frowned upon in many nations, the United States included. In fact, numerous European nations have outlawed this kind of waste disposal. Several techniques have been evaluated since landfilling is not a considerable management option. In order to dispose of or reuse the inorganic waste percentage (known as residuals) that remains after biodegradable materials have been destroyed, waste treatment is one possibility.

Wastes may be biodegraded by aerobic composting, anaerobic digestion, and mechanical biological treatment. Anaerobic digestion and aerobic composting could be applied in decomposing wastes and transforming them into useable composts in case organic components can be eliminated from inorganic materials. Composts, collected from organic wastes such as yard trimmings, animal manure and food scraps, may be used as a natural fertilizer if the circumstances are right. Aerobic composting integrates arranging organic wastes in predetermined proportions in containers, heaps, and rows, either indoor or outdoor facilities with gas treatment and collection systems. Wood chips as well as other bulk agents are integrated to garbage to accelerate the rate of organic components' aerobic decomposition. In the end, the substance is cured, which is a process of stabilization and maturation during which harmful microorganisms are eliminated. Composting generates carbon dioxide gas, water, and useable compost as its final products.

There is a wide range of possible uses for compost. Compost has several uses than just being a great soil additive for plant culture. It may be used to clean up polluted water sources including soil, groundwater, and even stormwater. Keeping the composting process under tight control is essential to ensuring high-quality results, but it may be a lot of work. Compost that is not fit for its projected use could be generating if its operational conditions are not critically managed and monitored. Irrespectively, composting is currently attracting significant attention, with approximately 80 million tons of wastes being saved from landfill trashing streams in 2008, up from about 14 million tons in 1979. This detour saved more than 177 million tons of carbon dioxide in 2008, which is the same as the annual emissions from 33 million cars [11].

For certain operations, oxygenated systems just cannot be used. However, anaerobic systems can be used in their place. The anaerobic digestion process integrates organic waste degradation in containers without the availability of oxygen. Carbon dioxide and methane, as well as their residuals are generated during the process of anaerobic breakdown

(biosolids). Biogas may be utilized as a fuel source or to generate power, while the leftover material can be put to good use as a soil amendment or fertilizer. Wet wastes are better degraded by anaerobic digestion than dry wastes, which are better degraded by composting. The capacity to gather biogas that could then be put to effectual use is one of the main reasons why anaerobic digestion is favored over conventional waste disposal methods like landfilling. Anaerobic digestion is suitable strategy of waste degradation compared to landfill disposal. Mechanical biological treatment (MBT) [12] is an alternative strategy, despite the fact that it is not widely used in countries such as United States. The European market has embraced this option, though. This process involves putting trash through a series of mechanical and biological procedures that decompose organic matter inside to lower the trash's overall volume. Crushing, shredding, and sorting are all the different samples of mechanical activities, which get the wastes ready for the next phase, which could either be anaerobic digestion or aerobic composting, the biological treatment of last resort. When the waste material has been reduced via biological processes, it may be incinerated.

V. CONCLUSION

The advent of the industrial revolution and the first widespread usage of fossil fuels have had a profound effect on the natural world. More and more people are giving some thought to this issue, and rightly so; we cannot let this business to expand at the expense of the natural world. Sustainable development is an idea that has emerged as a result of this style of thinking. The continuation of industrial growth while minimizing negative effects on the environment is implied by this idea. Altering an ecosystem may have far-reaching consequences for human health due to the negative effects of contaminants already existing in the environment. The industrial style of production that was designed to make man the ruler of nature instead threatens the existence of both humans and the natural world. Air, water, and land pollution have all reached worrisome levels. The world still contains landscapes and areas that are inaccessible to humans. The natural resources were recognized and safeguarded by law. The majority of a man's day is spent in an urban or industrial setting, and he spends just fleeting minutes at a time in a pristine natural setting. Certain wastes pose a particularly serious risk to both ecosystems and human health. This threat was not immediately appreciated by the firm. Regulating garbage disposal is an area that is currently lacking in many nations. Due to the widespread use of pesticides in agriculture and the production of industrial waste that contains poisonous and carcinogenic compounds, the volume of hazardous trash has expanded substantially in recent years. Loss of biodiversity, soil depletion, deforestation, and supplying of clean water are only some of the worldwide environmental challenges that have arisen as a result of the worsening environmental condition in nations and areas where environmental degradation is most acute. Sustainable waste management aspires to minimize contamination to the surrounding environment. One helpful technique for extracting as much value as possible from trash is recycling. Most nations choose recycling because it offers economic benefits in addition to trash reduction. The use of recycled raw materials also helps save energy.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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