Environmental Impact Assessment of the Petroleum Industries: A Review

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Abstract:

This research aims to shed light on the phenomenon of environmental pollution and its effects on the environment in general, and oil pollution in particular. In recent years, pollution has taken many forms, significantly impacting the composition of natural elements, such as air, soil, and water pollution. The impact of pollution then extends to all areas of human life. The research reviewed the environmental and economic effects of oil pollution. The gasses released during the evaporation or breakdown of spilled oil particles make oil and its derivatives extremely hazardous. In addition to crude oil, other harmful gasses including hydrogen sulfide (H2S) are also present in oil. Oil poses a significant threat to marine life, as it can poison or kill marine organisms. The effects of an oil spill range from immediate to long-term. Immediate damage is felt in marine animals and plants that live on the water surface, such as birds and seals, while long-term damage occurs as a result of the oil's decomposition and its negative impact on the marine food chain. In addition, spilled oil poses a risk to industrial facilities and oil refineries, due to the potential for fires or explosions, increasing the economic and environmental damage associated with these incidents. The greatest impact is on desalination plants, as toxic hydrocarbons can contaminate drinking water, causing these plants to shut down for potentially extended periods. Oil spills have significant economic impacts, including production shutdowns, impacts on fish stocks, and the high costs of combating and cleaning up affected beaches. The invasive emissions from the oil factories contribute to the occurrence of acid rain. Acid rain is the third most significant environmental problem in the world after global warming and ozone depletion. It is the most significant problem resulting from local air pollution, which is carried by winds across the borders of neighboring countries and causes serious damage to terrestrial and aquatic ecosystems and human health.

Keywords: Environmental Impact Assessment, Water Pollution, Oil Pollution, Acid Rain, Soil Pollution, Air Pollution.

1. Introduction:

The widespread spread of industries has led to significant environmental pollution, as pharmaceutical industries (Sabah J. Mohammed et al., 2023b), dye industries (Ali et al., 2024; Khalaf et al., 2025), minerals industries (M-Ridha et al., 2021), and oil industries (Cordes et al., 2016; M-Ridha et al., 2022) are among the most prominent causes. These industries throw their liquid, solid, and gas waste into the environment, which pollutes the air, water, and soil (Al-Musawi et al., 2024; S. J. Mohammed et al., 2021). Drug and chemical waste contribute to the deterioration of water quality (Sabah J. Mohammed et al., 2021), while greenhouse gas emissions from the oil

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industry exacerbate climate change (Cordes et al., 2016; M-Ridha et al., 2022). The mineral industry also produces heavy and dangerous materials that harm environmental systems and threaten human health (M-Ridha et al., 2021). Drug industries contribute to environmental pollution through the drainage of chemical waste and antibiotics to water sources, which affects anti -aquatic systems and leads to antibiotic resistance (Ibrahim et al., 2022; M. S. Salman et al., 2022). As for the manufacture of dyes, it releases toxic chemicals and heavy minerals in the air, water, and soil, which causes severe pollution and poses a danger to human health and living organisms (Ali et al., 2023; Aziz et al., 2023). The oil industry is one of the largest pollution causes, as it leads to greenhouse gas emissions that contribute to climate change, in addition to oil leaks that destroy marine and coastal environmental systems. In general, these three industries pollute the environment across the air, water and soil, which negatively affects the health of the planet and living organisms (Cordes et al., 2016).

Recent decades have witnessed a remarkable expansion in the activities of exploration and development of oil and gas deposits in the depths of the oceans, driven by the depletion of surface resources, easy to extract and accelerated in specialized maritime technologies (Farrington, 2014; Rocca et al., 2013). However, expansion of the exploitation of deep-water resources has not always been accompanied by legislative frameworks that reflect the latest practices in the field of environmental preservation. Hence the urgent need to integrate the current scientific knowledge with the environment of the depths of the seas with the known human effects on deep ecosystems, as well as the unification and development of the separate environmental protection measures in force so far (Rosa et al., 2017a).

Arab countries face an environmental challenge due to the negative environmental impacts of industrial development. All countries must adopt integrated industrial environmental management systems. Given the support of all countries in the region for development in all forms of investment, whether state-owned or private, they have a global obligation to achieve a quality system in production in accordance with the requirements of ISO 14000, which supports the preservation of the industrial environment internally and externally (Boughton et al., 2004). Industrial performance is strongly influenced by changes occurring in strategic industries, particularly given their significant contribution to the sector's output and the manufacturing industry's reliance on extractive industry products as raw materials for production (Gyawali et al., 2023; Rosa et al., 2017a).

As for the oil refining, transportation, and extraction industries in oil and natural gas-extracting countries, the hazardous nature of the industry requires the adoption of high-performance, low-emission technologies to ensure the safety of the facility and its workers, in addition to the value of petroleum compounds (Wake, 2005). This creates an economic incentive to conserve raw and manufactured materials within oil-based extractive and manufacturing industrial processes (Aldaood et al., 2022). However, this does not reduce the environmental impacts produced by the remains of petroleum industries that have no economic value and are disposed of in deserts and rivers, emitting gaseous emissions and affecting the soil, water and air during their decomposition or seepage into groundwater (Ekins et al., 2007; Santos et al., 2018). All countries must integrate environmental dimensions when setting standard notes for industrial products and studying the life cycle of products to ensure the reduction of industrial waste, the occurrence of integration in production, the reduction of hazardous waste and the remanufacturing of product components after the end of their useful life (Maaroof et al., 2023).

Environmental considerations must be taken into account at all stages of industrial production, with studies examining the impacts of production processes on the work environment and methods for reducing industrial pollution and emissions using economically and technically appropriate means. This includes ensuring the optimal use of available project resources and directing environmental management to address potential environmental impacts, including effects on solid materials, corrosion, and toxic threats. Appropriate methods should also be used to recycle or safely dispose of waste, and sufficient information should be provided to decision-makers about the project's environmental impacts to ensure sustainable planning and implementation (Isah, 2012).

This review study aims to conduct a comprehensive evaluation of the environmental impact of oil industries, by identifying the levels of pollutants resulting from them and analyzing their repercussions on the various environment, ecosystems and human health. The study also seeks to discuss the effects of oil production operations and related pollution sources, while reviewing the methods and practices approved to reduce these effects and enhance environmental sustainability.

What is the environmental impact of petroleum industry activities, and how can this impact be assessed using the Integrated Environmental Assessment (IEA) approach to determine pollution levels and potential environmental risks?

2. Methodology for selecting and analyzing studies

The research relied on the analytical theoretical review approach, setting clear criteria for selecting studies and controlling the analysis process to ensure comprehensiveness and accuracy in presenting results and conclusions.

The studies were selected based on the following criteria:

1. They must have been published in peer-reviewed scientific journals during the period (2010-2025).
2. They must address a major environmental aspect of the petroleum industry (such as air, water, or soil pollution).
3. They must contain quantitative data or qualitative analysis relevant to environmental assessment processes.

3. Oil Pollution

3.1 Sources of Water Pollution by Oil

Some oil tankers empty the contents of their oil waste into seawater. These oily substances reach the coast, polluting the coastal environment and affecting coastal wildlife. They also affect drinking water, as many countries use seawater for drinking after analysis. Oil tankers sinking or colliding with other ships also one of the sources of oil pollution of water. Other sources of water pollution by oil release during exploration and drilling activities in submerged marine environments, which can lead to the death of countless seabirds, fish, dolphins, and numerous marine creatures, spills may occur due to the explosion of oil wells at sea, oil production equipment located at sea or on beaches, or chemical corrosion of marine oil pipelines. Another cause of marine pollution is the dumping of petroleum industry waste into seawater (Kuzhaeva et al., 2018).

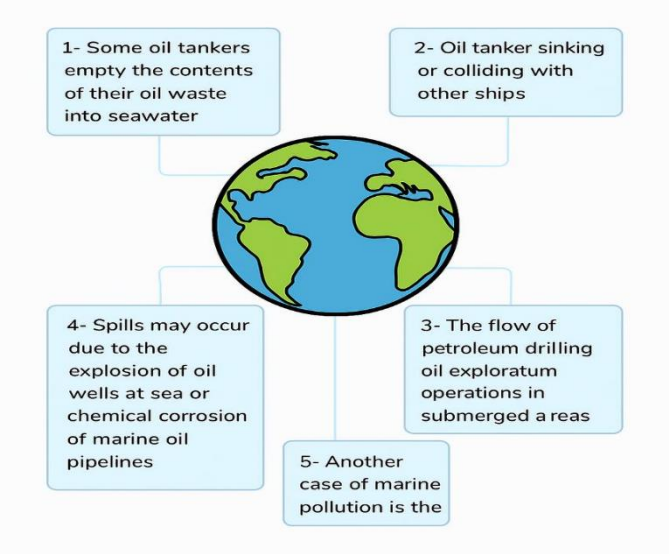

Figure 1. Sources of Water Pollution by Oil

3.2 Combating Oil Pollution

One approach to responding to oil spills is to employ floating booms to contain and limit the spread of oil slicks, along with the use of absorbent materials that partially impede the movement of the slick, such as fiberglass employing suction techniques to separate the oil from the water by using specialized equipment, such vacuum cleaners, to suck up oil slicks, utilizing tools that skim the thick coating of oil that floats on the water's surface. Pumps are used to gather and remove the skimmed oil; Bacteria can be used to counteract oil contamination. According to some researchers, and oil slicks can be converted into extremely tiny droplets in water by a variety of microscopic creatures that can break down oil molecules at the same time (Rehman et al., 2017). Processes that an oil slick undergoes as it travels through the environment by means of Spreading, Drifting, Evaporation, Natural Dispersion, Water-in-oil Emulsification, Dissolution, Oxidation, Sedimentation and Biodegradation (Baokang,

1989).

3.3 Environmental and Economic Effects of Oil Pollution

Oil pollution has significant environmental effects, including: -

3.3.1 Toxic Effects

Oil and its derivatives are considered highly toxic due to the gases emitted during evaporation or decomposition of spilled oil particles, as well as because oil, especially crude oil, contains other toxic gases such as hydrogen sulfide (H2S) (Smith et al., 2011).

3.3.2 Environmental impacts on marine organisms and systems

Oil affects and harms marine life, causing poisoning or death. The damage caused by an oil spill can be immediate or long-term. Immediate damage affects marine animals and plants on the water's surface, such as birds or animals close to the surface, such as seals. Long-term damage occurs when the oil decomposes and impacts the food chain of these marine organisms (Moore et al., 1974).

3.3.3 Impact on Industry

Spilled oil has an impact on factories and oil refineries due to the risk of fires or explosions. The greatest impact also threatens desalination plants, as drinking water can mix with toxic hydrocarbons, causing these plants to shut down for potentially extended periods (Samia et al., 2018). Table (1) shows relationship between oil industry outputs and environmental pollution manifestations.

Table (1): The relationship between oil industry outputs and environmental pollution manifestations

Type of oil output	Examples of major pollutants	The affected environment	Manifestations of resulting pollution	Potential environmental impact
Carbon emissions	Sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), methane (CH_4), volatile organic compounds (VOCs)	Atmospheric air	Air pollution, acid rain, smog	Increased global warming, deteriorating air quality, and human health risks
Liquid waste	Drilling water, produced water, hydrogenated oils, chemical solvents	surface and groundwater	Water pollution, high salinity, low dissolved oxygen	Destruction of the aquatic system, death of fish and aquatic organisms
Solid waste	Oil tank sediments, contaminated mud, spent oil filters, hydrocarbon-contaminated soil	Soil and land	Soil pollution, decreased fertility, accumulation of heavy metals	Degradation of agricultural land, difficulty of environmental rehabilitation
oil spills	Crude oil, petroleum	Seas and coastal	Oil slicks, isolating	Marine life death, food

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	derivatives	waters	oxygen from marine organisms	chain disruption
Noise and vibrations	Drilling, transportation and refining operations	Auditory environment and nearby communities	noise pollution	Biological stress to humans and animals, wildlife disturbance

3.3.4 Economic Impact

An oil spill has significant economic impacts, including halted production, impacts on fish stocks, and the high costs of combating and cleaning up affected beaches (H. A. Salman, 2016).

4. Acid Rain

Acid rain is one of the most significant environmental problems resulting from industrial activities, especially oil plants. Oil refining and the burning of fossil fuels release large quantities of polluting gases such as sulfur dioxide and nitrogen oxides. These gases react in the atmosphere with water vapor to form acids that fall as rain as acid rain. This rain negatively affects soil, water, and plants, and also damages buildings and metals. Therefore, oil plants are a major source of acid rain in industrial areas.

After ozone depletion and global warming, acid rain is the third most significant environmental issue facing the planet. It is the most prevalent issue brought on by local air pollution, which is transported over neighboring nations' borders by winds and seriously harms both terrestrial and aquatic ecosystems as well as human health. (Kowalok, 1993). Major industrial areas, major urban centers, and their surrounding areas, located opposite prevailing winds, are among the areas most affected by acid rain due to the high levels of air pollution caused by gases emitted by industrial activity and human activities that rely on the combustion of fossil fuels (coal, oil, and natural gas).

The simplest definition of acid rain is the chemical combination of water molecules in the air with molecules of certain gases also present in the air or deposited on the Earth's surface, forming acidic compounds (Bhargava et al., 2013). For example, water molecules (H2O) in the atmosphere (in either condensation or precipitation) chemically combine with carbon dioxide molecules (CO2), one of the atmospheric gases, producing carbonic acid (H2CO2). The resulting acids accumulate as a result of the combination of water molecules and certain atmospheric gases above the Earth's surface in its various forms (bedrock, agricultural soil, agricultural crops, natural vegetation, buildings and structures, etc.), and within water bodies (lakes, rivers, seas, oceans, and the aquatic organisms they contain) (Alrawi et al., 2022). This has a direct or indirect impact on the health of humans who benefit from these terrestrial resources, as well as on most of the natural cycles in which the Earth's surface interacts with the atmosphere (the water cycle, the cycle of certain gases such as carbon, sulfur, nitrogen, etc.), affecting changes in the chemistry of the atmosphere and the levels of some other environmental problems associated with gases, such as global warming (Bhatti et al., 1992).

The impact of acid rain on the Earth's surface varies depending on the distribution of a number of factors, most notably air pollutants, water vapor in the atmosphere (and the subsequent formation of various forms of condensation and precipitation), the amount of precipitation, and the movement of air masses. Many international efforts, particularly by the Group of Major Industrialized Nations, are underway to reduce the emission of gases that cause acid rain and mitigate the resulting environmental damage(Sivalingam et al., 2024). Acid rain has become widespread, particularly in the regions of these countries, and poses a threat to neighboring regions or even thousands of kilometers away. The greatest concern for the world's population is the problem of acid rain, which one environmentalist described as a slow-moving disaster that continually destroys plants, lakes, rivers, and their bounty. It also causes erosion of stone and metal structures (J. K. C. Nduka et al., 2008). Due to the seriousness of this problem, West Germany's losses in one year were estimated at approximately $600 million due to the destruction of agricultural crops caused by this rain. It was noted that in

Moses Lake, located west of the Adirondack Mountains and surrounded by tall trees that extend along its shores, giving it a serene beauty, not a single trout or frog croaks on its shores, as they once were. A few years ago, it was rich in fish and frogs. The diving ducks have abandoned it, and the hunting bird, which dives into it in search of food, has disappeared. About fish, all of this is due to acid rain (McCormick, 2013).

In 1967, Swedish scientist Svante Oudin observed that the acid rain falling in Sweden was increasing in acidity over time, and he called it "man's chemical warfare on nature." Later, current studies have shown that the primary cause of acid rain is the power plants and massive industrial centers spread throughout many countries, which burn enormous quantities of fuel and release increasing quantities of gases into the air daily, such as sulfur dioxide, hydrogen, and nitrogen oxides (Likens et al., 1979).

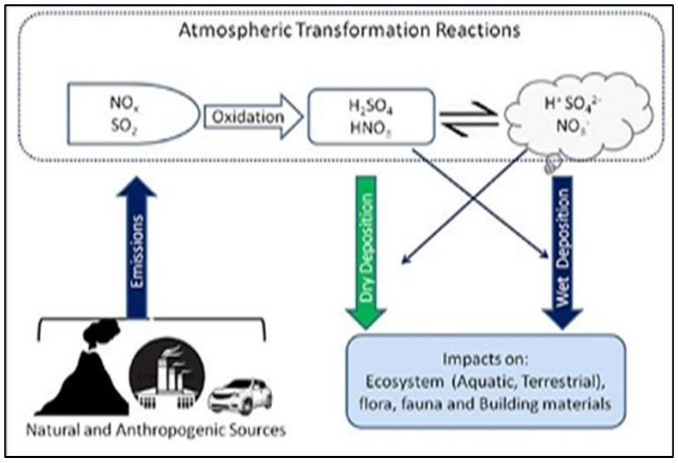

Figure (2): The reasons for the formation of acid rain, their mechanisms and their effects on the environment (Sedyaaw et al., 2024)

4.1 The Formation of Acid Rain

Acid rain is formed as a result of chemical reactions between sulfur-containing gases, particularly sulfur dioxide, and oxygen under the influence of ultraviolet radiation from the sun. Sulfur dioxide then combines with water vapor in the atmosphere to form sulfuric acid, which remains suspended in fine mist and is carried by the wind over long distances (Bhatti et al., 1992). It can also react with other gases, such as ammonia, to form secondary compounds such as ammonium sulfate. In dry, acidic conditions and the possible absence of summer, sulfuric and ammonium sulfate aerosol particles hang in the still air, creating a light fog (J. K. Nduka et al., 2016). Nitrogen oxides and sulfur oxides in the atmosphere react with water, oxygen, and ultraviolet radiation, forming acids such as nitrous acid and sulfuric acid. Under suitable weather conditions, these acids dissolve in rainwater and fall to the Earth's surface as acid rain, contributing to environmental pollution and damaging effects on ecosystems and infrastructure (Parungo et al., 1987).

The following two observations must be made in this regard: The first observation: Polluting gases are transported by air currents. Studies in Scandinavia confirm that the quantities of sulfur gases are (2.0) times higher than what is emitted by its factories. Meanwhile, the amount of sulfur gases in the atmosphere of Western European countries, especially the United Kingdom, is limited and stable at very low levels, not exceeding (20-30) %.

This indicates that these polluting gases are transported example, the acidity of the rain that fell in Sweden in 1982 was ten times higher than that of 1969, indicating an alarming increase in rain acidity. In 1979, the acidity of rain recorded values of 4.5 in the United Kingdom, 3.8 in Canada, and 1.5 in Virginia, where the acidity of Virginia's rain was close to that of sulfuric acid. In Scotland, the acidity reached 2.7 in 1977, and in Los Angeles, it reached 3 in 1980—more acidic than vinegar and lemon juice. It is worth noting that the geographical distribution of acid rain is not limited to industrialized countries; polluted clouds can travel long distances, causing acid rain in areas far from industrial pollution sources. (Liu et al., 2019).

4.2 The Negative and Destructive Effects of Acid Rain on Ecosystems

4.2.1 The Impact of Acid Rain on Lakes and Water Bodies

Studies indicate that acid rain significantly impacts the environment of lakes, affecting approximately 15,000 of the world's 18,000 lakes, leading to a decline in the numbers of

many organisms, especially fish and frogs. The increased acidity of water is attributed to the transport of sulfuric and nitric acids into lakes via floodwaters and rivers resulting from acid rain. This rain also carries various heavy metals, such as mercury, lead, copper, and aluminum, which contribute to the mortality of organisms. In addition, acidic water dissolves alkaline compounds present in base rocks or transported by rivers and floods, releasing bicarbonates and other compounds that contribute to adjusting the pH balance in lakes (Wright et al., 1995).

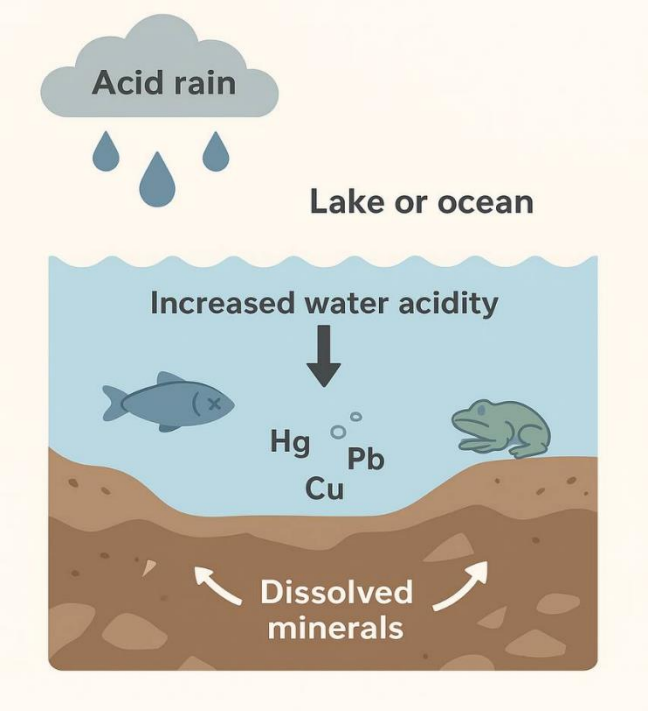

Figure (3): The effect of acid rain on lakes or oceans

4.2.2 The Effect of Acid Rain on Forests and Plants

The destruction of forests has an impact on the ecosystem. It is noteworthy that forest production constitutes approximately 15% of the total production of organic matter on the Earth's surface. It is sufficient to remember that the amount of wood used by humans in the world exceeds 2.4 billion tons per year. Forests planted in one square kilometer produce 1,300 tons of oxygen and absorb about 1,640 tons of carbon dioxide during one growing season. Acid rain also affects economic plants with seasonal crops and coniferous forests, stripping trees of their leaves, disrupting the soil balance and thus disrupting absorption in the roots, resulting in significant crop losses (Agnovianto et al., 2020). Other plants can also be damaged by acid rain, but the effect on food crops is minimized by the application of lime and fertilizers to replace lost nutrients. In cultivated areas, limestone may also be added to increase the ability of the soil to keep the pH stable, but this tactic is largely unusable in the case of wilderness lands (Bhargava et al., 2013).

Figure (4): The damage to the plants as a result of the effect of acid fog (Bhargava et al., 2013).

4.2.3 The Effect of Acid Rain on Soil

Soil pollution is defined as the corruption that affects the soil, altering its natural, chemical, or biological properties and characteristics, causing it to negatively impact, directly or indirectly, the lives of humans, animals, and plants living on its surface. Soil pollution can also be defined as any physical or chemical change to the soil that causes an obstruction to its exploitation (Boudehane, 2014).

Reports indicate that soils in European regions are becoming increasingly affected by acidity, leading to severe damage from reduced activity of nitrogen-fixing bacteria and a reduced rate of organic matter decomposition. The accumulation of a dense layer of plant residues reduced soil permeability to water, hindering seed germination and resulting in reduced forest productivity (Tabatabai et al., 1985).

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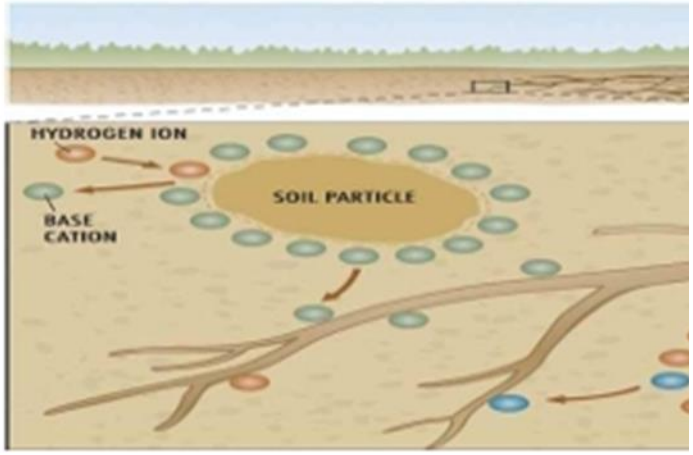

Figure (5): The effects of acid rain on the properties of the soil (Bhargava et al., 2013).

4.2.4 Environmental Effects of Acid Rain on Animals

The health of each component of an ecosystem depends on the health of the others. For example, industrial smoke is a major source of pollution, while acid rain reduces the availability of food and shelter for rodents, causing them to die or hide in burrows. As a result, predators that feed on these rodents are affected, as their populations may decline or be forced to migrate (Ferenbaugh, 1975).

Acid rain also affects crustaceans and small fish in lakes with acidic environments, causing them to die due to the formation of toxic compounds from the acids. These compounds enter the tissues of plants and phytoplankton, affecting the entire food web of the ecosystem (single-celled floating plants). When crustaceans and small fish consume them, the toxic compounds concentrate in their tissues to a greater extent. Thus, the toxic substances concentrate in the secondary and tertiary consumers, becoming fatal in the food chain. It is important to note that an ecosystem cannot function properly if there is an imbalance in its producing, consuming, or decomposing components. As a result, the death of forests leads to the death of many small animals and the migration of larger ones, and so on (Bhargava et al., 2013).

4.2.5 The Effect of Acid Rain on Humans

Smog forms in large cities. It contains acids and remains suspended in the atmosphere for several days. This occurs when pollutants from transportation are severely exposed to ultraviolet radiation from the sun. Chemical reactions occur between their components, leading to the formation of smog that looms over cities, especially in the early morning hours (Goyer et al., 1985).

Nitrogen dioxide is considered one of the most dangerous gases, playing a pivotal role in the chain of photochemical reactions responsible for smog formation. This gas causes a group of chemical compounds that negatively impact human health, causing irritation and congestion of mucous membranes, coughing, breathing difficulties, and tissue damage. Exposure to it also reduces the rate of photosynthesis in green plants, affecting their productivity and physiological functions (Sivalingam et al., 2024).

The harmful effects of pollution gases occur during thermal inversions, as observed in London in 1952, when intense smog persisted for three days, resulting in the deaths of approximately 4,000 people. Similar phenomena have been recorded in Ankara and Athens. In addition, acid rain resulting from air pollution leads to the deterioration of industrial facilities, historic buildings, and statues, requiring massive repair costs that can equal a significant portion of the per capita or national income. Prominent examples include the disintegration of some stones in the Tower of London and Westminster Abbey. Nitric acid also reacts with metals used in industrial facilities, causing significant corrosion and damage (Agnovianto et al., 2020).

5. Cleaner Production and the Environment

5.1 Cleaner Production

Integrating cleaner production into industrial processes conserves energy and raw materials, reduces the generation of toxic waste, and eliminates pollutants that cause environmental damage. Cleaner production reduces negative environmental impacts throughout the product's lifespan. It incorporates environmental considerations into product design, facilitating its use and maintenance, and recycling the bulk of the product at the end of use (De Oliveira Neto et al., 2016).

The concept of production radically differs from the traditional

approach to treating final waste products by minimizing waste volume and reducing energy costs. This will reduce capital costs and reduce energy costs. This will lead to lower capital, operating, and maintenance costs through the application of cleaner production technologies. This will increase production efficiency, reduce unproductive production, improve work experience, maintenance, and cleanliness, and boost morale (Demirbas, 2011).

Therefore, it is necessary to establish an independent, self-managed institutional organization to manage the environment within the industrial facility, which will encourage the industry to improve its efficiency and provide modern programs for industrial operations. In this case, industrial facilities need to borrow to finance expansion and renovation projects, so banks and industrial financing institutions must take into account the requirements of cleaner production (Greenberg, 1981).

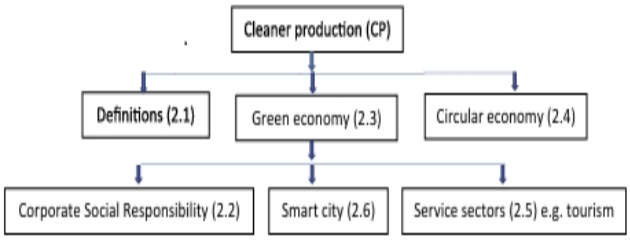

Figure (6): Cleaner Production and the Environment (Hens et al., 2018).

5.2 Cleansing Production Applications for Resource Management and Reducing Pollution

Cleaning production is a basic and practical research field, as it is based on various concepts and methodologies that contribute to addressing environmental and economic challenges (Gavrilova et al., 2010). Research efforts in this field focus on a wide range of industrial and societal sectors with the aim of understanding and managing integrated systems effectively, by studying operations at different levels, allowing dealing with sustainability issues in their environmental and economic dimensions comprehensively controlling pollution sources and rationalizing resource use, improving the work environment, monitoring industrial pollutants, reducing hazardous waste generation, environmental management and policy system(Almeida et al., 2013).

5.3 Barriers to Cleaner Production

The cleaner production approach has enabled companies to embody the concept of environmental sustainability in a practical way, while strengthening the conviction that higher productivity can be achieved using fewer resources, as well as reducing the associated environmental burden. However, despite the increasing levels of acceptance and application of this approach, it is still not adopted as a standard procedure for managing environmental aspects (Moors et al., 2005).

To explain and understand the barriers to cleaner production, they include many things such as economic barriers and it is include project costs, technical barriers and it is include a lack of information and technical expertise, quality considerations and it is include consistent product quality, barriers to accessing information and it is include language barriers, which require the translation of information and documents into Arabic to ensure widespread dissemination, social barriers and it is include excess labor, which hinders the implementation of cleaner production programs that require fewer workers(Vieira et al., 2016).

5.4 Areas of Cleaner Production

Cleaner production strategies for the oil industry focus on training and preparation of specialists, use of environmentally friendly materials, recycling and reuse, safe waste handling, development of manufacturing processes and mechanisms, production planning and industrial process control, product life cycle, quality and environmental management, periodic environmental auditing (Hens et al., 2018).

5.5 Cleaner Production Objectives in Industrial Facilities

Develop manufacturing methods and introduce appropriate modifications to the product lifecycle, from extraction to manufacturing, transportation, storage, use, and disposal in an environmentally safe manner, take environmental considerations into account in all industrial production processes (Agha et al., 2002).

Inform relevant official authorities of information related to

health or environmental risks and take appropriate preventive measures, use alternatives for the transportation and use of chemicals and the disposal of their waste in environmentally appropriate ways, operate production units in a manner that protects the environment and the health and safety of workers and citizens, study the impact of production on the work environment and methods for reducing industrial pollution and emissions using economically and technically appropriate means and Safely handle solid and hazardous waste and use appropriate methods for recycling or disposing of it(Grutter et al., 2004).

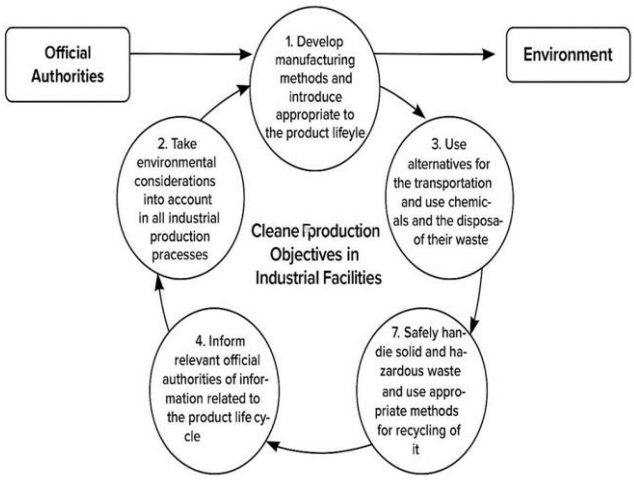

Figure (7): Cleaner Production Objectives in Industrial Facilities

6. Environmental Impact Assessment

Although definitions of this most important component of integrated environmental management systems vary, the most common definition is that it is a predictive and evaluative process of impact of an activity on surrounding environment. Based on this combined impact, along with the economic, social, and health impacts on the natural environment, a study report is prepared. This requires decision-makers to work on proper planning and project implementation to avoid negative impacts and maximize positive impacts (El Badry Fadl, 2021).

This process helps countries achieve sustainable development with minimal harm to their environmental and human resources. The importance of environmental impact assessment studies for projects stems from the involvement of more than one specialist in studying the environmental impact, as it encompasses social and economic aspects and basic natural changes, namely: water, soil, air, and biological life (Sachs, 2012).

These areas may be negatively or positively affected by the implementation of the project in the proposed areas. The goal of the study, conducted during the project planning phase, is to predict the positive and negative aspects of the project in a way that maximizes the positive aspects, increases their impact, and minimizes the negative aspects (Alam et al., 2010). Countries and peoples must realize that no project on earth exists and will never exist without negative side effects, and that all it will achieve are positive aspects in all areas, as some officials claim. There are many mega-projects that have drained millions of people's wealth and have not been successful due to their lack of environmental assessment (Morgan, 2012).

Environmental impact objectives can be divided into immediate objectives, which are achieved and their impact felt throughout the project's life cycle, and long-term objectives, which emerge as a cumulative result of applying sound environmental management requirements, defined through environmental impact assessment studies. These objectives can be formulated as follows (Zhao et al., 2014):

1. Immediate (Short-Term):
   Improving the integration of environmental considerations into the project cycle at an early stage and adhering to standards, improving the environmental design of the proposed project, ensuring optimal use of the project's expected environmental resources, defining mitigation and environmental management measures(Lima et al., 2001) That are appropriate to the project's expected environmental impacts, ensuring the participation of stakeholders and those affected by project activities, providing sufficient information to decision-makers about the project's environmental impacts, contributing to the achievement and availability of capital and project costs, protecting it from unforeseen risks, ensuring its continuity and Project acceptance locally and internationally(Costantini et al., 2004).

2. Long-Term:
   Contributing to the achievement of integrated natural resource management, ensuring the achievement of sustainable development goals in planning and decision-making, contributing to the improvement of social and economic aspects within the project environment, protecting the rights of individuals and society to enjoy a better life (Clark, 1984).
3. Managing Environmental and Assessing Impacts of Projects:
   Reviewing the environmental status of the selected site, the project characteristics, and the proposed alternatives to achieve the development goal by a group of specialists in environmental impacts and environmental feasibility studies for projects(Dey, 2001), the specialized team selects the significant impacts to focus on and how to avoid or mitigate them during the project phases(O'Rourke et al., 2003), predicting the future environmental reality resulting from the project's impact and selecting the alternative with the least impact on the surrounding environment in all its natural, social, and biological aspects(Rosa et al., 2017b), Conduct a public meeting with community groups positively and negatively affected by the project to obtain their approval or express their opinion on the project and take appropriate steps to mitigate their economic and social impact(Okedu, 2020). Conduct environmental monitoring by the country's environmental authorities to ensure the required changes are made in compliance with environmental specifications (Godø et al., 2014). Reduce financial burdens, expedite project implementation, and prepare white, black, and gray lists due to their multiple negative impacts. The black list is for negative impacts, while the white list is for limited impacts (Adeola et al., 2021).
   The gray list is for small industrial projects. Risks of Tetraethyl Lead, these substances have been proven to have a negative impact on the environment and human health in particular, causing numerous diseases, including cancer. Therefore, countries and manufacturing companies around the world have turned to alternatives, including MTBE (Seyferth, 2003).
   Use of MTBE has been discontinued in most countries, except in small quantities, as it has been proven to have a significant impact in reducing friction between the piston and cylinder in the combustion chamber of the engine. For example, in the United States, the addition of this substance is permitted at a rate of 0.01 grams per liter. Tetraethyl lead is a toxic substance, and symptoms of poisoning for those who work with it include a drop in blood pressure and a drop in body temperature, followed by a severe headache with vomiting, which leads to fainting and sometimes death. Lead also appears in the urine analysis of the infected person (Sarkar, 2020).

7. Summary of Main Findings

- The review results showed that the oil industry is one of the most prominent sources of environmental pollution in industrial areas, particularly in terms of gaseous emissions and liquid waste.
- Studies indicated clear impacts on the quality of air, groundwater, and soil surrounding refinery sites and oil facilities.
- It was found that the absence of integrated environmental management systems contributes to the exacerbation of negative impacts and limits the effectiveness of remediation measures.
- The analysis results indicated that implementing continuous environmental monitoring programs and adopting modern remediation technologies contribute to significantly reducing the environmental impact.
- The research concluded that it is necessary to strengthen environmental legislation and activate monitoring systems in the oil industry to reduce polluting emissions and leaks.

8. Conclusion

The increased use of oil and its derivatives has increased the volume of environmental pollution, especially given the increasing reliance on this resource as a primary source of energy, the extent of excessive environmental damage is primarily due to market failure or failure of environmental policies, society can achieve optimal levels of environmental pollution when the total costs of pollution are as low as possible.

Society can achieve optimal levels of environmental quality when it is able to maximize the benefits achieved from improving environmental quality to their highest value, oil companies bear most of the environmental violations resulting from oil activity, and thus do not fully assume their environmental responsibilities.

Therefore, their environmental performance is far removed from their statements and positions regarding their responsibilities toward the environment in which they operate, natural gas in Iraq can generally play a significant role in improving the environment, instead of flaring, which is one of the most significant causes of pollution, as the amount of gas flared exceeds 80%.

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