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Environmental aspects of natural resources and their relationship to the exploitation of fossil fuels: A reflection on sustainability

Aspectos ambientales de los recursos naturales y su relación con la explotación de combustibles fósiles: una reflexión sobre la sostenibilidad

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ABSTRACT

Fossil fuels are used throughout the world as the main sources of energy, they are present in nature thanks to the accumulation of biomass over millions of years. Although many countries depend largely on exports of oil and its derivatives to maintain their economy, fossil fuels have caused pollution to the environment due to their extraction from the subsoil, causing harmful effects on the human being and the environment as a result of the operations related to their exploitation. This bibliographic review article exposes a series of theoretical and conceptual considerations about the effects of the exploration, exploitation, and production of fossil fuels such as oil and gas, focusing on the negative effects that these activities cause on natural resources in Colombia. and Latin America, in addition to considering different measures to prevent and mitigate the impacts caused.

Keywords: Environmental impact, natural resources, hydrocarbons, water, soil, air, hydrocarbons, exploitation, mitigation.

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RESUMEN

Los combustibles fósiles se utilizan en todo el mundo como las principales fuentes de energía, están presentes en la naturaleza gracias a la acumulación de biomasa durante millones de años. Aunque muchos países dependen en gran medida de las exportaciones de petróleo y sus derivados para mantener su economía, los combustibles fósiles han causado contaminación al medio ambiente debido a su extracción del subsuelo, causando efectos nocivos en el ser humano y el medio ambiente como resultado de las operaciones relacionadas con su explotación. Este artículo de revisión bibliográfica expone una serie de consideraciones teóricas y conceptuales sobre los efectos de la exploración, explotación y producción de combustibles fósiles como el petróleo y el gas, centrándose en los efectos negativos que estas actividades causan sobre los recursos naturales en Colombia. y América Latina, además de considerar diferentes medidas para prevenir y mitigar los impactos causados.

Palabras claves: Impacto ambiental, recursos naturales, hidrocarburos, agua, suelo, aire, hidrocarburos, explotación, mitigación.

1. Introduction

The exploitation of fossil fuels has spread considerably over time, becoming a fundamental part of the development of the world economy. Energy consumption is growing at an average rate of 3.4% per year. World oil production has maintained steady growth in recent years of 1.2% annual average, and in 2012 reached a volume of 86 million barrels per day. Global energy consumption, meanwhile, has followed the same trend, with steady growth since 2000 [1]. Global energy needs are increasing more gradually compared to the past, but still increasing by 30% from now until 2040, which is equivalent to adding the total demand of China and India to the current world demand.

The process of exploitation of fossil fuels consists of locating deposits that may be marine or terrestrial; Using small explosions and the analysis of the seismic waves caused on the surface, the area with the greatest possibility of proven reserves is delimited, then the process of hoisting the drilling tower, the installation of the machinery, and the drilling of the reservoir is carried out [2]. The production of reservoir fluids can occur naturally or through artificial mechanisms used in wells that are connected by a network of pipelines for subsequent treatment and transport.

The upstream sector is responsible for carrying out the first tasks of the oil production process, covering the stages of exploration, drilling, and production of fossil fuels, in these processes the most considerable environmental impacts such as deforestation, soil destabilization, erosion, groundwater pollution, water birth losses, and biodiversity occur [3]. In other words, the exploitation of hydrocarbons affects natural resources precisely, depending on the location of the deposits and the recovery techniques used.
Seismic explosives have caused damage to the environment by producing radial disclose at the point of detonation, diverting the course of groundwater, and affecting the water table. After a while, the fractures generated by the detonations are saturated with water; At night when the temperature drops these waters can suffer frostbite, which translates into an expansion of the water, which causes the fractures to continue propagating [4]. Also, drilling wells around the world generate millions of barrels of waste, mainly cuts and drilling muds; The management of these wastes is the biggest environmental problem by causing problems of deforestation, affectation of biological resources, erosion, and deterioration of water resources. In addition, during the production of hydrocarbons, underground aquifers can be contaminated permanently, with hydrocarbons, through pipes that are generated by the annular space of the well, due to poor cementation of the lining, or through the interconnection of artificial fractures with abandoned or poorly cemented wells, or with natural faults.

As additional consequences of the activities of the upstream sector, we can highlight smog, acid rain, the decrease in the ozone layer, and the increase in the greenhouse effect due to venting operations. “Smog” is a set of polluting mists that cause serious effects on living beings (affectation of the respiratory system, photosynthetic activity, among others) and materials (corrosion of metals), and the classic and photochemical are distinguished. The classic is characterized by the presence of CO, CO_2, SO_3, and SO_2 and a large number of suspended particles, and the photochemical are characterized by photochemical reactions between NO_x, VOCs, and O_2, giving rise to oxidizing molecules (O_3, peroxyacetyl nitrates, free radicals). These pollutants mostly come from burning fossil fuels [5]. The degree of this environmental impact depends on different characteristics such as the composition of the associated gas, the method of disposal, flaring or venting, and the efficiency of the burning.

Despite the relevance of tropical regions for the global climate balance, the essential biodiversity they host, and the refuge of hundreds of indigenous communities, the oil industry sees these areas as potential opportunities for expansion for its interests. Currently, new fronts are forming for the development of fossil fuel exploitation in the Peruvian, Bolivian, and Ecuadorian Amazon, the Colombian plains, the Orinoco basin, and delta, and the Central American Atlantic coast [6]. In this current scenario, the present work reflects on the impacts caused on the environment by the exploitation of fossil fuels, it is important, not only as a way to address the problem but also to seek ways to mitigate them, to seek more sustainable.

2. Methodology

For the preparation of this article, 50 bibliographic sources were consulted, including articles from scientific journals, technical books, and sustainability reports, of which 4% were written in English and the remaining 96% in Spanish, from this the most relevant information for a bibliographic review was identified, consulting databases such as Scopus, Scielo, Science Direct, Google academic, Ambientalex, the institutional repository Lumieres, among others; taking as a reference the research material both nationally and internationally; In addition to the following as a search for information, the following words were used: “Environmental impact, natural resources, hydrocarbons, water, soil, air, hydrocarbons, exploitation, mitigation”. In this way, it is intended to examine possible mitigation strategies for the negative effects caused to the environment.

3. Results and Discussion

3.1. Fossil fuel overviews

It is a set of remains of organisms that have been present on Earth and, after being subjected to the heat and pressure of the earth’s crust for hundreds of millions of years, has formed and contained a large amount of energy. Its formation is due to a natural process of aerobic decomposition of dead and buried organisms. Over the years, this decomposition has become a hydrocarbon capable of containing energy [7]. These are used for most of the daily activities of society such as transport, energy generation, air conditioning of environments, and agriculture, among others.

A. Physicochemical properties

Fossil fuels are made up of hydrocarbons that mostly have nonpolar characteristics and are not very reactive at room temperature. The appearance of unsaturated links generates differences in their reactivities according to the type and arrangement of these [8]. Depending on the transformation process that the organic remains that make them up have suffered, they will have been transformed into one type or another of fossil fuel, but all of them obtained as a result of a fossilization process in environmental anoxia (absence of oxygen), where organic matter has not been degraded by microorganisms but remains in the form of complex organic molecules. The main fossil fuels are oil, gas, and coal.

B. Upstream fossil fuel exploitation sector

Large oil companies are the main generators of energy for the planet and are important sources of income for the countries where they reside. These companies develop various macro-processes that, by their nature, produce impacts on the environment [9]. The stages of exploitation of fossil fuels in this industry, as already stated can be subdivided into three large areas which are exploration, drilling, and exploitation [10]. The change from upstream to downstream occurs when the crude oil is transported to the place of processing or refining (Fig. 1). However, the main element of the upstream process is geological analysis and exploitation of oil reserves.

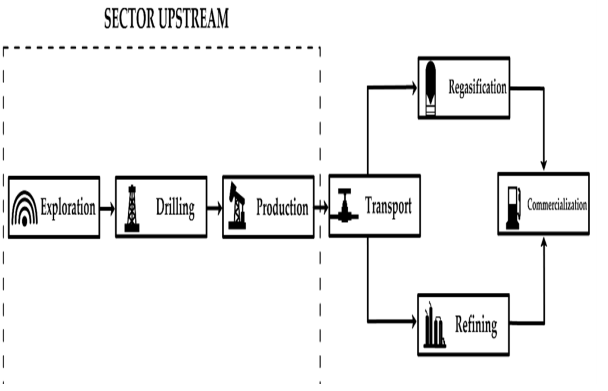

Figure 1. Value chain exploitation of hydrocarbons.

3.2. Impacts generated by the exploitation of fossil fuels

Hydrocarbons are fossil fuels widely used around the world as fundamental generators of various forms of energy, they are in nature thanks to the accumulation of biomass over millions of years. However, it is possible that in its extraction contamination in water and soil is generated due to constant accidental spills, which are very common in producing countries [11]. In addition, during these stages, there is a waste generation, and pollution by the emission of gasses on the soils, causing deforestation due to the trails that are built to penetrate places of natural reserve or importance for environmental conservation.

The environmental impacts derived from the use of a geological resource can occur at different times: during the capture or extraction of the resource, its transport, storage, and treatment processes, and, finally, in the direct use of the resource [3, p.43]. The management of natural resources is based on the components of life that are mentioned about the conservation, promotion, coordination, remediation, mitigation, and implementation of actions assigned to the integral management of the environment, through the execution that involves the protection, education, and restoration of resources [12]. Therefore, it is also important to work on developing local capacities in environmental matters and institutionally strengthening communities for the construction of

new practices that shield and guarantee the correct use of natural resources.

The degree of environmental impact that a discharge or discharge can have on the environment depends on the pollutant loads contained in the waste and the environment where it is discharged [13]. According to the Ministry of Environment, Housing and Territorial Development of Colombia [14], during the life of a project, the impacts generated on biotic, abiotic, and socioeconomic environments must be taken into account. To this end, an environmental impact assessment is carried out, which must include the identification and interpretation of the interaction of both the region's activities and the processes of the activities to be developed with the environment.

Although in Colombia the consequences of natural disasters have not been quantified, some of the aspects to be considered are the paralysis of productive activities in the surrounding bodies of water, crops and livestock production, the loss of property value, rapid changes in land use and tenure, population migration, massive deaths of flora, fauna, and epidemics due to changes in the ecosystem, social disorders, economic recession, environmental pollution and as a great effect, the increase in vulnerability throughout the affected region [15]. Oil spills in the country have occurred due to various circumstances, including voluntary, accidental, or attacks by groups outside the law. In some circumstances, these situations have been generated in sectors of the country that are difficult to access, preventing the development of surveillance and control strategies or, in this case, recovery. Some spills were caused by outlaw groups in 2015. This type of situation alters the quality of the landscape and the provision, regulation, support, and cultural services provided by ecosystems for the normal development of human life [8, p.155].

As for the impacts of oil in Ecuador, the well-known "Texaco era" can be considered as a reference, referring to the operation of the Texaco company in the Ecuadorian Amazon. In addition, the identification and evaluation of the social impacts of oil activity have been one of the most complex issues of analysis and understanding. It is difficult to distinguish the socio-economic effects that derive from structural factors specific to national society, from those effects that are the product of the influence of oil activity. However, social impacts are an effect of pollution by toxic substances, which result in effects on human health due to exposure to oil pollution. For example, the results of a sampling conducted in the Texaco area of operation show concentrations of 46,423 to 405,634 nanograms (10−9 grams) of polycyclic aromatic hydrides (PAHs) per liter of water and 96 to 2,500 micrograms (10−6 grams) of benzene per liter of water, as a result, the cancer risk factor is multiplied by 100. When the company began drilling for oil in Ecuador, there were no cases of cancer in the region, but after forty years, it is one of the most relevant health problems. In a census of 80 communities in these exploited regions in the Amazon, a very high incidence of cancer was discovered, specifically stomach, bladder, and mouth cancer [16].

On the other hand, the Peruvian jungle is also affected by the exploitation of hydrocarbons due to poor environmental management that has led to the contamination of water bodies, and large tracts of soil, which subsequently cause the loss of animals and, consequently, the disappearance of the main source of

food for many inhabitants of the area. However, the groups of populations in federations and associations have been achieving favorable results regarding the titanic task of this recovery of sites and improving the quality of life for their own [17]. By demonstrating that oil activity is unsustainable due to the presence of some factors in the extraction areas, related to both direct and indirect impacts on the environment, synergistic or cumulative, residual or persistent, generated during the development of economic activity [18]. Companies are not applying remediation techniques properly, processes are not guaranteed to fully remedy the impact caused, and the use of these technologies can cause even more damage to affected sites.

A. Environmental impacts on soil

The soil and subsoil constitute a natural resource that plays important roles in the development of life. Its role as a filtering medium during the recharge of the aquifer and its protection are highlighted. In addition, they are part of the process where biogeochemical, hydrological, and trophic web cycles occur. Finally, they are the space where agricultural, livestock, and vegetation support activities are carried out. Therefore, when they come into contact with all the waste generated by the exploitation of fossil fuels, they could significantly radically change their physicochemical properties [19].

The spillage of hydrocarbons either by management or distribution causes negative effects on the ecosystem since they undergo processes of transformation, degradation, and phase change, which mainly involve volatilization, dissolution, emulsification, and sedimentation of the same. All of them affect soil fertility, plant growth, as well as the existence and survival of the animals that feed on them [20]. In productive soils, pollutants impede the production of sowing and harvesting, harming the social and economic parts of this activity [8, p.155]. In other words, several physicochemical processes occur in contaminated soil, depending on the hydrocarbon that was spilled and the environmental conditions of the site. Fossil fuels cause high toxicity that disadvantages protein structure and causes dehydration and denaturation of cells, thus harming soil-dwelling microorganisms [21]. These microorganisms are essential for any ecosystem because they can decompose some of the hydrocarbon particles and minimize their impact on the soil, in the same way, they contribute to the growth of vegetation that functions as a food base for the animals that are present in their ecosystem.

In addition to this, all the transformation of the space where the oil industry develops generates soil compaction and erosion, sedimentation, destruction of living organisms that play an important role in the nutrient cycle, contamination with inorganic compounds (sulfates and salts), and organic compounds (especially hydrocarbons) [22]. In Colombia, the exploitation of fossil fuels has been considerably affected during the last 18 years by permanent terrorist activity against the oil pipelines and facilities from which it is extracted. In the soil, hydrocarbons prevent gas exchange with the atmosphere, initiating a series of simultaneous processes such as evaporation and penetration, which, depending on the type of hydrocarbon, temperature, humidity, soil texture, and amount discharged, can be more or less slow, causing greater toxicity, in addition to having a moderate, high or extreme salinity, making its treatment difficult [23]. In addition, fossil fuels tend to accumulate and generate a hydrophobic layer, causing inhibition of vegetation growth and the modification of microorganisms typical of the soil environment.

On the other hand, in the Peruvian jungle, in 2016, there were 13 spills in the North Peruvian Pipeline, plus e1 occurred in July of this year. Of these 14 spills, 13 occurred in the northern jungle of Peru (two in the Amazonas and 11 in Loreto), four were due to corrosion, and nine were due to third-party cuts. At present, there is no information on the exact amount spilled, nor on all bodies of water and soil affected, however, it is known that remediation activities are still being carried out [14, p.56]. To avoid these situations, it is necessary to optimize operations and take preventive measures to prevent damage to hydrocarbon production and transport pipelines.

B. Environmental impacts on water

Humanity depends to a large extent on the consumption of fossil fuels, and although alternative energies are currently sought, the use of oil and gas is considerable, that is, the demand for these sources is maintained; Therefore, there is a need to continue exploiting this natural resource and with it the need to face the new conditions in which the hydrocarbon finds itself and the requirements to turn it into an offer for consumers [24]. In general, in this dynamic, important effects are caused on the surface and underground water resources.

Colombia is considered one of the countries with the most biodiversity in the world, in addition to being a country rich in aquifers, rivers, streams, and stoppages

among others, which today is a relevant and positive aspect, since, as a result of climate change and strong environmental pollution [25]. The greater flexibility of legislation (water, agrarian, environmental) has provided certainty to capital to penetrate regions of great natural wealth (jungles of Central and South America, deserts and mountains in Mexico and South America) and with the availability of strategic resources (aquifers, glaciers, oil, minerals). This has been done based on environmental depredation, i.e. overexploitation of aquifers, pollution of rivers and water bodies, and diversion of natural water sources [26]. Pollutants of rivers, lakes, and other natural resources have their main origin in anthropogenic activities and soil vulnerability for small and large urban areas; However, rural areas do not escape polluting human activity, as sewage contains human and animal excreta, chemical, and industrial waste from private or state companies, pollutants from mining or oil exploitation [27]. All these factors lead to poor water quality if it is not treated correctly to be within permissible limits.

The impacts produced in the drilling stage are generated mainly by mud and drilling cuts, due to the use of toxic materials in the fluids, where their drawback is the generation of polluting waste to the environment. Other impacts can include biodiversity loss, deforestation, erosion, use of natural resources, breakdown of water flows, and noise [28]. The most obvious about water sources is the modification in the physicochemical and bacteriological properties of surface waters, by decreasing their quality due to the increase in pH, resulting in the eutrophication of slow bodies, increased fish mortality, and affectation of the communities surrounding the areas of exploitation.

Other impacts on these aquatic ecosystems are caused directly by the oil extraction process and specifically by the use of large amounts of water to heat the oil and separate it from the sand [29]. The alteration of natural drainage patterns in the most severe cases has led to the drying up of large areas of wetlands. It is known that the areas where oil exploitation has developed most strongly correspond to the middle valleys of the Magdalena and Momposina depressions, areas of great fishing wealth, sustained by the largest wetland systems in Latin America after those of Mato Grosso in Brazil [30]. Governments should therefore ensure that these biodiversity-rich and human-important areas are protected.

In particular, the coastal strip of the Bay of Santiago de Cuba exhibits the deterioration of its natural resources due to oil pollution, which has negatively influenced fishing yields, the influx of tourism, and the development of coastal communities [31]. Oil also damages marine vegetation, as in high concentrations it inhibits photosynthesis. This is very serious, as plants play a key role in primary production which is the basis of the energy economy of coastal and marine ecosystems [32]. One of the results of exploration and production operations is abandoned wells, which affect organisms by the accumulation of oil at the bottom of rivers, causing lethal effects on animals and plants vital to the ecosystem, because toxic compounds in the oil are not soluble in water, aquatic organisms can suffer clogging of the respiratory tract and damage to the respiratory tract which affects the chain food and therefore the natural balance of the ecosystem [33]. Biologists point out that fishing areas are polluted for long periods. Therefore, the more it has been exposed to contact with hydrocarbons, the longer the ecosystem takes to recover, in many cases, it takes up to decades.

C. Environmental impacts on air

In recent years, there has been growing concern about the possible effects on the climate caused by the progressive increase of pollutants in the atmosphere, as a result of human activities [34], much of the air we breathe is contaminated by compounds from the burning of fossil fuels [35]. The regions with the highest mortality rates are led by North America, Europe, and Southeast Asia, as a result of the highest concentrations of air pollution from fossil fuels.

In the operations of extraction, production, treatment, and transport of oil, and gas, volumes of gas are produced in low quantities or with a low content of hydrocarbons, so it is not feasible or profitable to market or use it as fuel, this gas produced is called associated gas [36]. The associated gas is composed mainly of methane gas which, in a high percentage, is not reused so it is disposed of by burning near extraction wells or direct release into the atmosphere [37]. This is a pollutant that is up to twenty-four times more polluting than CO_2; By burning methane in teas, it becomes a less harmful compound. However, that doesn't mean it's a good practice.

The first negative effects on air quality occur in the exploration phase in which high concentrations of PM10 and PM2.5 particulate matter are released into the atmosphere causing irreversible alterations in the health of humans and other biotic components [38]. In this regard, it is appropriate to differentiate the environmental impact of burning compared to that of venting. The associated gas flaring occurs using special combustion facilities, called flare stacks, and is particularly CO_2-generating, while venting is the direct emission of gas, mainly composed of methane [39]. The greenhouse effect of venting is much higher than that of burning because the Global Warming Potential (GWP) of methane is between 28 and 36 times greater than that of CO_2 [40]. These substances are extremely toxic and together with CO_2 are one of the main causes of thinning of the atmosphere, unpredictable climate changes, and global warming.

On the other hand, noise levels must be determined taking into account existing sources of noise generation, population settlements, housing, and social infrastructure. Monitoring should be carried out by taking sound pressure levels of noise emission in specific areas of the project's area of influence [41]. For example, it is known that seismic prospecting systems work based on air explosions that generate sound waves, without so far knowing studies that conclude on the impact that this type of waves can have on marine species, especially cetaceans and other marine mammals that communicate at great distances through sounds [42].

3.3. Pollution mitigation and control measures

Companies with service lines in the exploitation of fossil fuels must determine their environmental performance, being necessary to monitor compliance with management indicators of the service lines, criteria evaluation methods to maintain the management system, and determine the processes that need monitoring and measurement against current legal regulations [43]. In addition, the energy industries from non-renewable sources, as protagonists in climate change, must take action on the table and adopt immediate actions towards an energy transition, which must be carried out with the least amount of negative environmental impacts possible [44] and gradually, making sure to reach all the stages involved in the hydrocarbon value chain.

For the production of fossil fuels, technical improvements have been carried out as preventive measures for possible environmental impacts that may hurt natural resources during the operation; such as the implementation of portable pumps in Lot IX in Peru, and has allowed economic savings in the movement of crude oil through tanks, in addition to minimizing the oil spills that occurred as a result of this operation [45], together with the optimization of the process, energy expenditure is reduced to be carried out efficiently.

Currently, there are several biodegradation systems, whether in situ or ex-situ, which have been offered in the market aimed solely at the remediation of contaminated sites; Hydrocarbons are among the most frequently treated pollutants, which have quantitative results and lower economic costs [18, p.10]. In situ phytoremediation occupies an important position for the biodegradation of contaminated soils, it is based on the composition of plants and microbial communities, and this association is promising for the biodegradation of either contaminated soils or waterways. This technique has several limitations, one of them is the accessibility to the contaminated area, however, the ability of plants to extract toxic substances is thanks to their degrading activities due to physical and chemical factors associated with the roots [46]. Additionally, the plants help with the reforestation of the area and partially restore the physicochemical properties of the soil.

On the other hand, one of the most used techniques is "venting" known as ventilation, it is an in-situ soil remediation procedure. It consists of supplying oxygen through the use of pumps, in this way microbial growth is stimulated by increasing the activities of indigenous microbes. To obtain better results, soil conditions are modified by adding nutrients and moisture, achieving an improvement in biodegradation with the ultimate goal of transforming contaminants to a harmless state [47], to give them more effective management without further harming the affected ecosystem.

However, the oil industry has sought to reuse production water in different processes and activities at both agricultural and industrial levels, making the most of this fluid for the recovery of areas through crop irrigation or simply being used for drilling or hydraulic fracturing operations [48]. Strategies such as water injection, discharges, allocation to other industries, agriculture, and even storage are mechanisms used in Colombia for the efficient management of this resource [49]. It should be noted that to implement these practices, water must be previously treated and comply with all the guidelines proposed by national regulations.

In Colombia, companies in the hydrocarbon sector focus the treatment system on the removal of oil, suspended solids, BOD5, COD, and temperature to pour or reinject the produced water. Because the volumes generated are different in each field and the final quality depends on the use, the processes are not the same in all cases [50]. It is important to consider the studies carried out in the main offshore areas of the world related to the practices and environmental impacts of the production of water on marine ecosystems. These case studies could form an initial basis for establishing policies and policy guidelines to protect marine species that inhabit the Colombian Caribbean [51]. This is essential because, in addition to having an environmental impact, it negatively impacts the socioeconomic components of the populations that depend on marine ecosystems.

The largest amount of water produced by the oil industry in Colombia is destined for underground disposal (disposal) at 58.2%, and surface discharges at 40.2%. In 2016, the volume of water destined for disposal was 120.03 million m^3 and for reinjection, it was 50.94 million m^3 [52]. Due to the high amount of water produced by the oil industry and its different characteristics, there is a certain proportion that is used for activities other than those described above. These are reuse in refining and petrochemical, agribusiness (irrigation), preparation of drilling muds, maintenance of wells, firefighting systems, and storage, among others, this refers to the circular economy, reusing the water produced in the upstream sector to use it in the other stages of the process.

To control and mitigate greenhouse gas emissions in the exploitation of fossil fuels, it is proposed to carry out maintenance and regular synchronization of equipment to minimize the possibility of emission of gasses without complete combustion, minimize methane and CO_2 emissions through a controlled discharge and flaring of gas and using equipment to capture and condense the gas for commercialization (green completion). Carry out well-cementing operations to ensure the elimination of possible channels that allow the migration of gasses to the surface and control the well so that the volume of gas remains at the established levels [53-56]. Additionally, natural gas losses from vents and leaks are a waste of a non-renewable resource of clean energy and an economic loss, so it is necessary to have all the control and monitoring equipment to mitigate the impact of emissions, in addition to taking full advantage of natural gas.

4. Conclusions

Although there is a regulation on the exploitation of fossil fuels and long environmental bidding processes. The physical-chemical properties, linked to fossil fuels, imply a great risk that will generate serious environmental impacts on natural resources in the short to long term, largely due to the great demand for processes that involve exploration, drilling, and production. With this, studies are needed to quantify and qualify the environmental problems related to exploration, so that, knowing the aspects of the problem, it becomes easy to search for more viable solutions, and implement sustainability policies aimed at implementing different clean energies and new technologies. that mitigate soil, water, and air pollution.

Currently, there is a new mentality of the large oil and gas exploration companies, changing the images of a company, more linked to the exploitation of a resource for a company that thinks to obtain energy by the most sustainable means possible. This modification of thinking denotes a way of solving this paradigm, thus making us think about a future, where exploring a resource will be linked to preserving it.

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