

Influence Characteristics of Offshore Engineering OaGD under Environmental Impact Assessment

Ankit Singh*

Gachon University, Republic of Korea

**corresponding author*

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Abstract: With the increase of society's demand for energy, the development of oil and gas resources has accelerated, and the environmental problems caused by it have become more and more prominent. Offshore oil and gas development (OaGD) engineering is a complex system engineering, which determines the The environmental problems are inevitably complex and diverse. This paper studies the current situation of OaGD in sea area A from 2015 to 2020, and finds that in the process of OaGD in this sea area, the discharge of oily production water increased in the early years, resulting in serious seawater pollution. Based on this, this paper calculates the contribution rate to analyze the impact of each link in the OaGD project in this sea area on the environment, and evaluates the impact of OaGD on the environment through five indicators: resource consumption, global warming, acidification, optical ozone, and biological toxicity. The results show that the oil and gas gathering and transportation stage of offshore OaGD has the least impact on all aspects of the environment, followed by the geological exploration stage, and the oil production stage has the greatest impact on the environment. Aiming at the problems existing in the OaGD and governance in this sea area, this paper also puts forward suggestions for improvement.

1. Introduction

Based on the objective demand for energy in the world, oil and gas resources have always been the objects that countries plan to exploit. However, compared with traditional energy exploitation projects in the fields of various countries, the application of environmental protection laws in the development and utilization of offshore oil and gas resources is subject to general treaty provisions. The implementation effect is poor, and there are problems of conflict with each other [1]. At the same time, the environmental impact assessment system also has the problem that the existing

guidelines are useless, and countries do not have uniform standards, implementation and application procedures for environmental impact assessment. This makes the development projects of offshore oil and gas resources at the current stage without the protection of a sound environmental protection legal basis and environmental impact assessment system [2].

At present, many scholars have achieved good results in the research on the impact and protection of marine environment in offshore OaGD projects. For example, a scholar investigated the sewage treatment work in oilfields and first pointed out that in order to improve the ability of sewage treatment, it is necessary to establish a corresponding management mechanism, and improve the layout of the pipeline network by introducing the marketization of oilfield sewage treatment. Secondly, it is believed that the environmental information system can effectively solve the problems of environmental information management, and the method of establishing the oilfield environmental information system is proposed to predict and analyze the discharge of oilfield pollutants [3]. A certain scholar proposed that the direct solidification of crude oil sludge is the easiest way to deal with such pollutants, which not only solves the problem of sludge pollution, but also recycles the waste [4]. When a scholar studied the adverse effects of offshore oil and gas exploitation on the water environment and ecological environment, in order to achieve the purpose of reducing pollution, he proposed that in the process of drilling, the drilling and cementing techniques should be improved, and the aquifers should be sealed to make the oil well. It is separated from the water layer to prevent oil and water from entering the sea and avoid seawater pollution [5]. Some scholars have done a lot of research on marine ecological effects. For example, some people have studied the characteristics of marine ecological environment and the ecological effect of aquaculture sewage on marine phytoplankton. Others have pointed out that the ecological effect evaluation should be based on the impact of pollutants on the ecosystem structure [6-7]. On the whole, many scholars have proposed environmental governance methods for offshore OaGD, and their research on the evaluation of marine ecological effects has also achieved remarkable results.

This paper firstly introduces the impact of offshore OaGD projects on marine ecology from two aspects, and then proposes a contribution rate analysis method, then studies the current situation of OaGD in sea area A, and uses the contribution rate analysis method to calculate the environmental impact of each stage of offshore OaGD. Finally, the pollution control problems in the OaGD in this sea area are analyzed from the perspectives of government and circular economy, and corresponding countermeasures for OaGD and environmental protection are put forward.

2. Environmental Impact Analysis of Offshore OaGD

2.1. The Impact of Offshore OaGD Projects on Marine Ecology

The main source of impact of OaGD projects on the marine ecological environment is the continuous discharge of petroleum substances in the production water, which causes long-term damage to water quality and marine zooplankton, which in turn endangers the ecosystem balance of the sea area [8].

(1) Impact on water quality and sediment

After the produced water discharged from oil and gas enters seawater, it will first affect the ecology of the sewage mixing area near the sewage outlet of the oil and gas platform. The oil film formed by the petroleum substances in the seawater will consume a lot of oxygen during the oxidation process, resulting in the lack of oxygen in the water body. The oil film will hinder the exchange of air and absorb sunlight radiation, resulting in an abnormal rise in water temperature and a continuous decrease in the dissolved oxygen content of seawater. However, after the petroleum substances are digested into the sediment by seawater, the degradation rate is slow,

and the phenomenon of enrichment will occur [9-10].

(2) Impact on zooplankton

Petroleum substances directly affect the growth and reproduction of zooplankton by affecting the density of phytoplankton, resulting in the death or migration of zooplankton, thereby affecting their population structure, and affecting higher-level marine organisms through the food chain, resulting in higher-level marine organisms the amount of reduction [11-12].

2.2. Contribution Rate Analysis Method

Contribution rate reflects the relationship between variables through the contribution of a variable. If A and B represent variables, then the correlation R between A and B can be reflected by calculating the relationship between variables [13]. In this paper, the contribution rate is calculated to reveal the correlation between each stage of OaGD and environmental variables in terms of pollution sources.

Its calculation formula is as follows:

$$R = \frac{N \sum AB - (\sum A)(\sum B)}{\sqrt{N \sum A^2 - (\sum A)^2} \sqrt{N \sum B^2 - (\sum B)^2}} \tag{1}$$

$$R \begin{cases} [0,0.05], A \text{ and } B \text{ are not related} \\ (0.05,1], A \text{ and } B \text{ are related} \end{cases} \tag{2}$$

3. Status of OAGD in Sea Area A

Table 1. Discharge of oily production water in this sea area

	2015	2016	2017	2018	2019	2020
Mass production of water(m ³ /a)	935742	1263581	1693965	1694358	2355417	254762
Oil into the sea(t/a)	8.62	13.79	21.63	23.24	28.57	30.14

As shown in Table 1, the water discharge of oil and gas production in a certain sea area from 2015 to 2020. The water volume data shows that production water discharges have grown steadily between 2015 and 2020. And from 2017 to 2018, the annual discharge of water was basically maintained at about 1.69 million cubic meters. From 2018 to 2019, the annual discharge of produced water increased significantly. From 2019 to 2020, the discharge of produced water increased steadily. The scale of oilfield production has increased.

Table 2. Oil and gas emission trends in this area from March to September 2020

	3	4	5	6	7	8	9
Oily sewage discharge(m ³)	43562.8	82581.3	94773.6	11458.7	116703.5	175492.4	190344.5
Oil content of sewage(t)	0.47	0.63	1.34	1.85	2.76	3.11	3.42

As shown in Table 2, the amount of oily sewage and oil discharged into the sea from March to September 2020 was analyzed. As shown in Figure 1, the amount of oily sewage and oil entering

the sea showed an obvious upward trend, and the discharge of oily sewage There are two periods of huge increase, one is between March and April 2020, from 43562.8m³ in March to 82581.3m³ in April, almost doubling; the other is July Between 116703.5m³ in July and 175492.4m³ in August. The amount of oil entering the sea in March was 0.47t, while the amount of oil entering the sea in September was 3.42t, an increase of 7.28 times.

4. Characteristics and Suggestions of Environmental Impact of OaGD Projects in Sea Area A

4.1. Analysis of the Results of Environmental Impact Assessment at Each Stage of OaGD

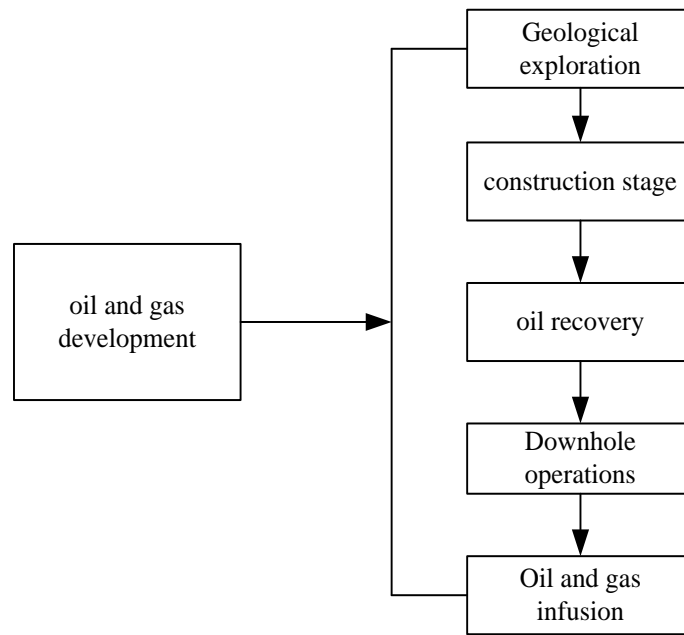


Figure 1. Offshore OaGD projects

As shown in Figure 1, in the actual offshore oil and gas exploitation project, it mainly includes geological exploration, construction stage, oil production stage, downhole operation, oil and gas gathering and transportation [14]. In the above links, limited by the nature of the work and the current technological level, each link will pollute the environment, especially as a liquid mineral, the pollution control work is more complicated and difficult than coal and metal minerals [15].

Table 3. Environmental impacts of each stage of OaGD

	Geological exploration	construction stage	construction stage	Downhole operations	Oil and gas gathering and transportation
Resource consume	9.63	17.85	48.97	11.54	4.08
global warming	12.78	26.37	33.61	8.96	3.46
acidification	13.59	15.34	25.72	37.62	0.83
Optical sampling	4.77	11.92	36.28	30.53	4.25
biological toxicity	1.23	16.55	44.18	19.74	9.66

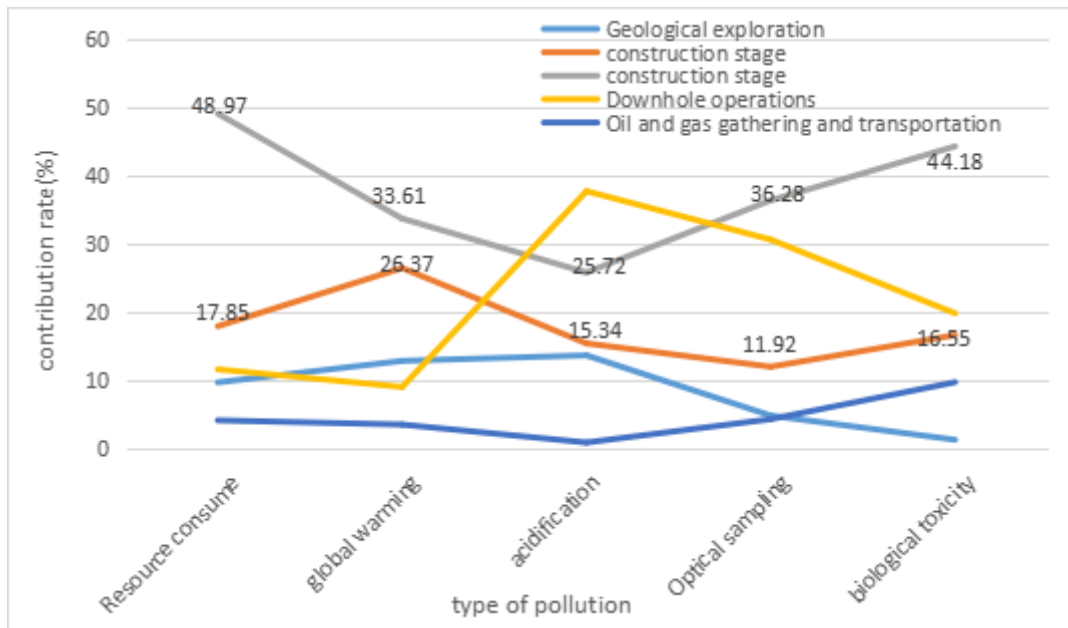


Figure 2. Analysis of Environmental Impact Assessment of OaGD and Utilization

As shown in Table 3 and Figure 2, the impact of OaGD on the environment is evaluated by calculating the contribution rate of each link of the OaGD project to resource consumption, global warming, acidification, optical ozone, and biological toxicity. The contribution rate of the geological exploration stage to these five items is 9.63%, 12.78%, 13.59%, 4.77%, 1.23%, and the impact on the environment in this stage is relatively small. The construction stage mainly includes the installation and commissioning of platform facilities, the laying of submarine pipelines and drilling operations. The main impact of related operations on the environment is the cuttings and mud discharged from drilling. The contribution rates of the construction stage to the five items are 17.85% and 26.37%. %, 15.34%, 11.92%, 16.55%, it can be seen that the impact on the environment at this stage is higher than that of the geological exploration stage, and the main pollution aspect is global warming. The contribution rate of the oil production stage to these five items is 48.97%, 33.61%, 25.72%, 36.28%, and 44.18%. This stage is an important stage for the emergence of environmental problems. In terms of resource consumption and biological toxicity, this stage has greater influence behavior. The contribution rate of the downhole operation stage to these five items is 11.54%, 8.96%, 37.62%, 30.53%, 19.74%, and this stage has a greater impact on acidification and photochemical ozone. The contribution rate of the oil and gas gathering and transportation stage to these five items is 4.08%, 3.46%, 0.83%, 4.25%, and 9.66%. When no accident occurs, this stage has little impact on the environment.

4.2. Problems Existing in Environmental Governance of OaGD in this Sea Area

(1) Government regulation failure

The impact of OaGD on the environment is complex and diverse. A specific environmental issue often involves the participation of multiple environmental protection departments, resulting in low law enforcement efficiency. Moreover, the policies formulated for environmental protection are not perfect, and they cannot encourage and restrain oilfield companies from various aspects to reduce environmental pollution. Coupled with insufficient law enforcement, even if relevant laws strictly regulate oil and gas field development activities, the lack of strict law enforcement will cause serious pollution to the environment [16-17].

(2) The development of circular economy is hindered

The petroleum industry in this sea area has gone through decades of development mode of pollution first and then treatment, predatory development, and extensive operation, which has resulted in serious environmental pollution. This problem has forced a change in the way the oil industry operates. At present, although the development of circular economy is vigorously advocated in the process of OaGD, the recycling of waste is promoted, and the impact of waste on the environment is reduced. However, many constraints were encountered in the development process [18]. For example, lack of scientific understanding, oilfield development has not yet reached a unified consensus on circular economy. In recent years, a large amount of waste has been generated while strengthening oil and gas exploitation. Due to the lack of understanding, the treatment of these wastes is only simple and primitive, which makes these wastes lose the value of recycling [19].

4.3. Environmental Protection Countermeasures for OaGD in this Sea Area

(1) The government requires the environmental protection department to improve the level of environmental supervision

In the process of OaGD, the atmosphere and water bodies are seriously polluted. An environmental incident often involves more environmental law enforcement departments. For example, if a safety accident causes environmental pollution, there will also be the intervention of the safety production supervision and management department. Although the intervention of multiple environmental protection law enforcement departments is conducive to dealing with environmental pollution incidents, it will also lead to the situation of multiple law enforcement, which will greatly reduce the efficiency of law enforcement and increase the cost of environmental enforcement. In response to this situation, the government needs to issue a regulatory order to the environmental protection department, so that the environmental protection department strengthens the connection with oilfield companies, and requires them to regularly report the implementation of environmental protection work to the government.

(2) Optimizing the internal resource allocation of oil companies

Oilfield companies should seize their main business and eliminate outdated production methods. Seize the opportunity of corporate restructuring and technological improvement. Taking the sustainable development of the industrial structure as the concept, the equipment with serious environmental pollution, large resource consumption and backward production technology is treated to obtain good environmental benefits. Strengthen the cooperation with foreign oilfield enterprises, introduce their advanced production technology and mechanical equipment with good energy-saving effect, and overcome the technical bottleneck of the development of circular economy in the petroleum industry.

5. Conclusion

People ignore the environmental benefits while pursuing the interests of offshore oil and gas resources development, resulting in complex and diverse impacts of OaGD on the environment. The contradiction between resources and environment is becoming more and more acute, which seriously restricts the sustainable development of the offshore oil and gas industry. A good environment is an important foundation for the sustainable development of the marine resources industry. From the perspective of sustainable development, we must coordinate the relationship between marine resources and the environment in order to make the marine ecosystem stable and harmonious. Based on the actual situation of OaGD in sea area A, this paper evaluates its impact on the environment in all aspects of development, and puts forward corresponding countermeasures to

deal with the environmental pollution caused by the OaGD process, aiming to promote resource conservation and an environment-friendly society 's build.

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Conflict of Interest

The author states that this article has no conflict of interest.

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