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Sustainable Spatial Development of Oil Investment Locations in Iraq) An Analytical Study of Environmental Impact (The site of the field Ahdab in Wasit province as a case study

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Abstract. The existence of a large oil industry leading the Iraqi economic sector has a pivotal role in economic development. Development in the oil sector, which follows geographical determinism, does not mean that it achieves economic development only, but must achieve sustainable development too.The process of investment as an engine for development in the oil sector, especially after oil contracts, which allowed the global companies to work in the oil sector in Iraq, contributed to increase the quantities of oil and gas production, and helped the sites near the oil fields to be more economically efficient.The research problem focused on the negative effects of the establishment and continuation of the work of oil investment projects on the local environment, including agricultural land area as well as soil, air, and water.The research aims to introduce the philosophy of environmental sustainability in oil investment projects, to achieve development for the societies near of the oil fields, and ensure that the environment is not damaged. This will be done by putting the hypothesis that: including the dimensions of sustainable environmental development within the adoption of oil investment policy, helps to improve the spatial development of the oil investment site and improve the quality of life of the community.Descriptive analysis used to study the environmental effects of the Ahdab oil field / Al-ahrar Nahiya / Numaniya Qada / Wasit province as a case study.The study found that there are significant negative impacts on agricultural land, air, water and soil. The local community quashinare represented by members of local governments (members of the provincial council, local council of Nu'maniyah, and the local council of the Al-ahrar Nahia), believe that the company's performance about theenvironmentis unsatisfactory.A number of relevant conclusions and recommendations were presented.

1. Introduction

Environmental considerations have become a very important factor in determining the establishment of some projects or oil sites.

1.1The problem of research.

The emergence of negative environmental effects resulting from the establishment and continuation of the work of oil investment projects on the local environment.

1.2The objective of the research.

to conduct an environmental assessment of the neighboring areas of oil investment projects, and to develop solutions to ensure that the environment is not damaged.

1.3The hypothesis of research.
that the inclusion of dimensions of sustainable environmental development within the adoption of oil investment policy helps to improve the conditions of oil sites and neighboring area.

1.4Methodology of the research.
the use of analytical descriptive method in the study of the environmental effects of the field Ahdab in Wasit province as a case study. A questionnaire will be made to views the local community awareness about the environmental impacts of the field.

1.5Location of Al Ahdab Field.
The field is located in the province of Wasit, south of the province of Baghdad, near Al-Ahrar, as shown in Figure 1. The field area (300) km2, run jointly by the Central Oil Company and the Chinese Oasis Company, carried out the contract in 2009 in the manner of providing technical services.

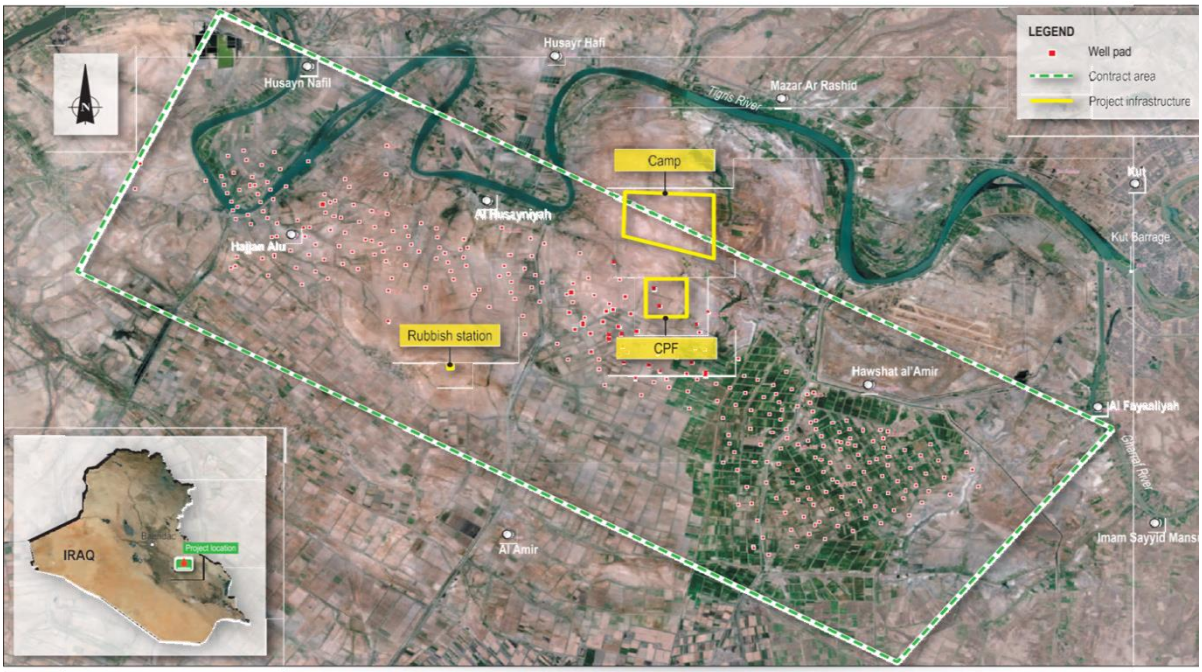

Figure 1. Location of the study area and the location of oil wells in the Ahdab field.
Source: Central Oil Company.

In order to clarify the work and activities of the field, the stages of field operations will be identified as follows:

1. Production and pumping of oil and gas

The number of oil wells at the case study is 398. The field has many activities such as processing, distribution, flow management of wells, camps, and water treatment units. It's also contains Water pumping lines, gas and oil export lines, and CPF.

In 2018, the field produced 113,000 barrels per day.

Crude oil and associated gas are received from the wells to the central processing unit (CPF) through the pipeline system. The process of crude oil production is liquefied gas, dry gas and sulfur. Separations, insulation and drying are carried out. Steam boilers are used, and the heat is pumped into the tanks.

2. Treatment of natural gas and sulfur

Natural gas liquids are separated by propane, and the production of sulfur gas is accompanied by about 6% of the total produced gas. The production rate according to an oil company is currently from sulfur to 20 tons per day, LPG (114) tons daily, dry gas 60 cubic meters per day.

3. Burn

There are three HPF and one Low Pressure (LP) flashlights in the CPF, which are lit for 24 hours seven days a week. Figure 2, which can emit polluting gases to the air.

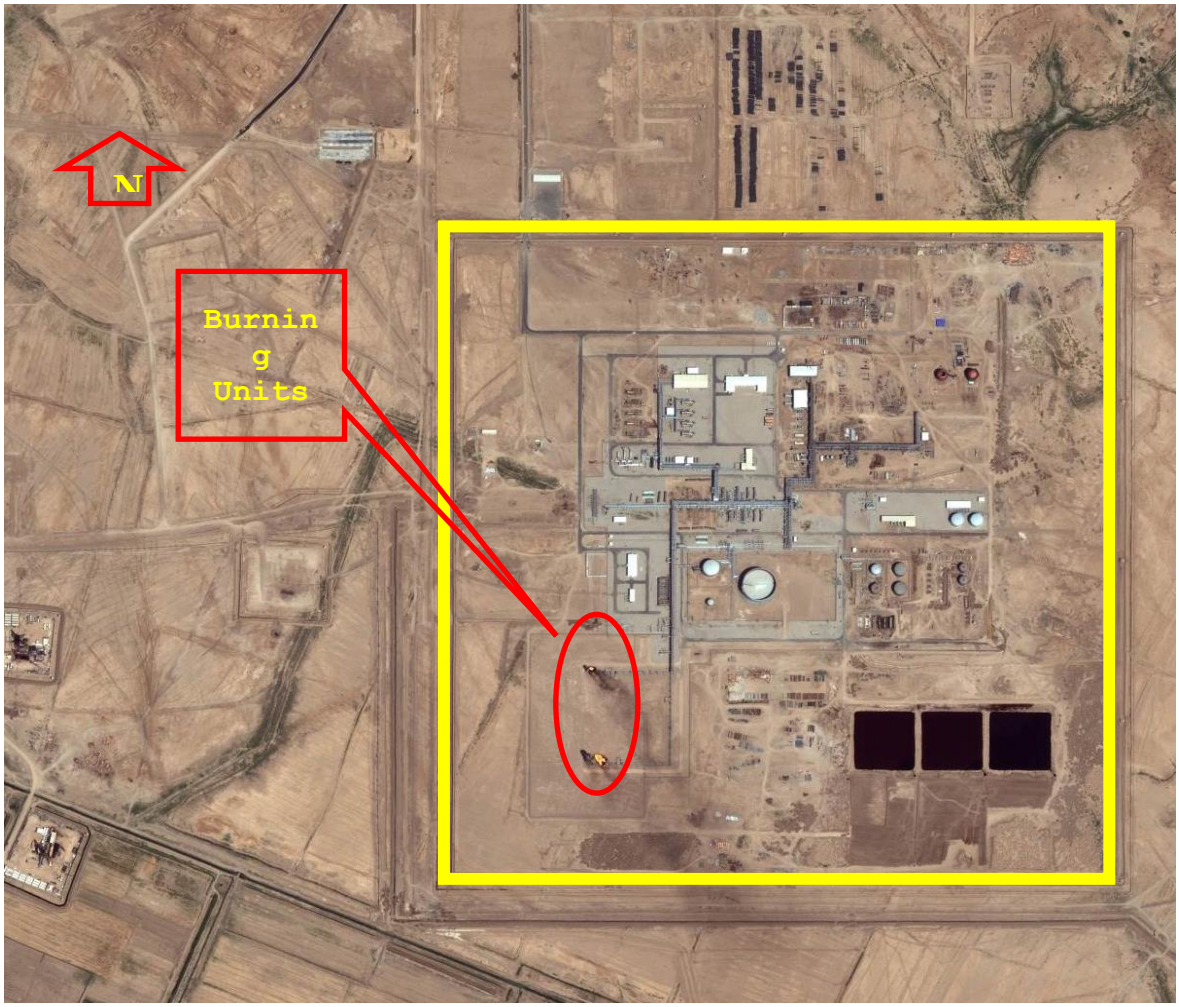

Figure 2. The location of the main production unit (CPF) and the burning sites.
Source: Wasit Governorate Council Based on the satellite image.

4. Storage and transportation

The reservoir area is located near CPF. It contains two 50000 m^3 reservoirs and a 10,000 m^3 emergency tank. A pipeline was set up to transport crude oil from CPF. Oil is transported by trucks from 90 to 120 trucks per day to transport 20,000 to 25,000 barrels per day to Doura refinery in Baghdad. Figure 3, spills may occur as a result of transport and storage of materials and products.

Figure 3. Collection of oil and gas reservoirs in the field

Source: Wasit Governorate Council Based on satellite images.

2. Water supply and management

Water pollution is: any physical, chemical or biological change of water, or any flow of liquids, gases or solids into water, either directly or indirectly, causing harm to public health, agriculture, industrial, economic or other legitimate uses [1]

The process of chemical synthesis is one of the oldest and most important methods used to improve productivity by improving the permeability of the inert class. This method has been applied since 1930. The layer was treated with acid to a certain depth that dissolves some rocks and also affects the cement bonding between the rock grains [2]

The field is depending on two water sources, the general estuary and the Tigris River, with a capacity of (300,000 barrels per day). The capacity of the treated water unit is 260,000 barrels per day. The CPF water injection plant controls the distribution of water for re-filtration and pumping of wells .

general estuary has a design capacity of 210,000 barrels per day. It supplies water to the field through 35 km pipes with a diameter of 20 kg to reach CPF of 185,000 barrels per day. The general supply station supplies 30,000 cubic meters of water to the wells and treatment units.

2.1Solid waste management

A solid waste treatment unit is located near the camp and deals with all solid waste from wells, cisterns and CPF. In 2012, 1,300 tons of solid waste was produced. This amount was related to the construction, and building the project.

The waste is disposed of after classification. Hazardous waste is collected and disposed of under the supervision of the Ministry of the Environment. Disposable solid waste (scrap, empty drums, and drums of chemicals) is authorized by the Ministry of Oil to be sold by auction.

3. Environmental Effects of Al Ahdab Oil Fiel

Environmental impacts vary and will be limited to research by addressing the environmental impacts, including:

1. Effects on air quality

The main land use of case study is agriculture and rural areas. There are no major industrial or commercial activities. Suspended particles and dust are to be affecting local air quality. The center oil company conducts multiple site readings throughout the year to quality of air. Table (1) shows the locations and the results air quality reading stations

Table 1. Distribution of air quality reading stations for the study area 2017.

Reading Station	Site	Coordinates (East, North
Aq1	Arab Abdullah	32.5167, 45.6319
Aq2	Aboud Al Hussein	32.4833, 45.6333
Aq3	Ajil al-Bashi	32.4667, 45.6333
Aq4	Hussein Al Amer	32.4667, 45.7167
Aq5	Naser	32.4333, 45.7000

Source: Ministry of Oil, Central Oil Company Unpublished data.

Table 2. Results of air quality readings for the study area 2018

Reading Station	Pollutant (μg / m3)				
	SO2	Nox	CO	Methane	hydrocarbon Non-methane
Aq1	94	114	95	0.06	0.09
Aq2	65	85	55	0.06	0.09
Aq3	75	85	85	0.08	0.11
Aq4	105	95	70	0.09	0.11
Aq5	135	125	70	0.09	0.12
Iraqi determinants	113	101	500	-	0.24

The readings (Aq1-AQ5) are shown on the satellite figure (4)

Source: Ministry of Oil, Central Oil Company Unpublished data.

It is noted from Table (2) that the underline shown values have exceeded the Iraqi determinants

4. Air Quality Urban Center

Subsequent clean air legislation and other regulatory actions led to the reduction of ambient air pollution in many regions of the world, and particularly in the wealthy developed countries of North America and Europe. New epidemiological studies, however, conducted over the last decade, using sensitive designs and methods of analysis, have identified adverse health effects caused by combustion-derived air pollution even at the low ambient concentrations that now generally prevail in cities in North America and western Europe [3].

In order to identify the effects of the field on the urban area (AL-AHRAR), a field car type (horeba) used to measure air quality. The car place is in department of agriculture, coordinates (N32.61058, E45.517500), at a distance 6.5 km from the center of field operations (pcf) (Figure 4).

The reading process continued for four hours. The wind speed was 6 km / h. The results of the readings were shown in Table 3.

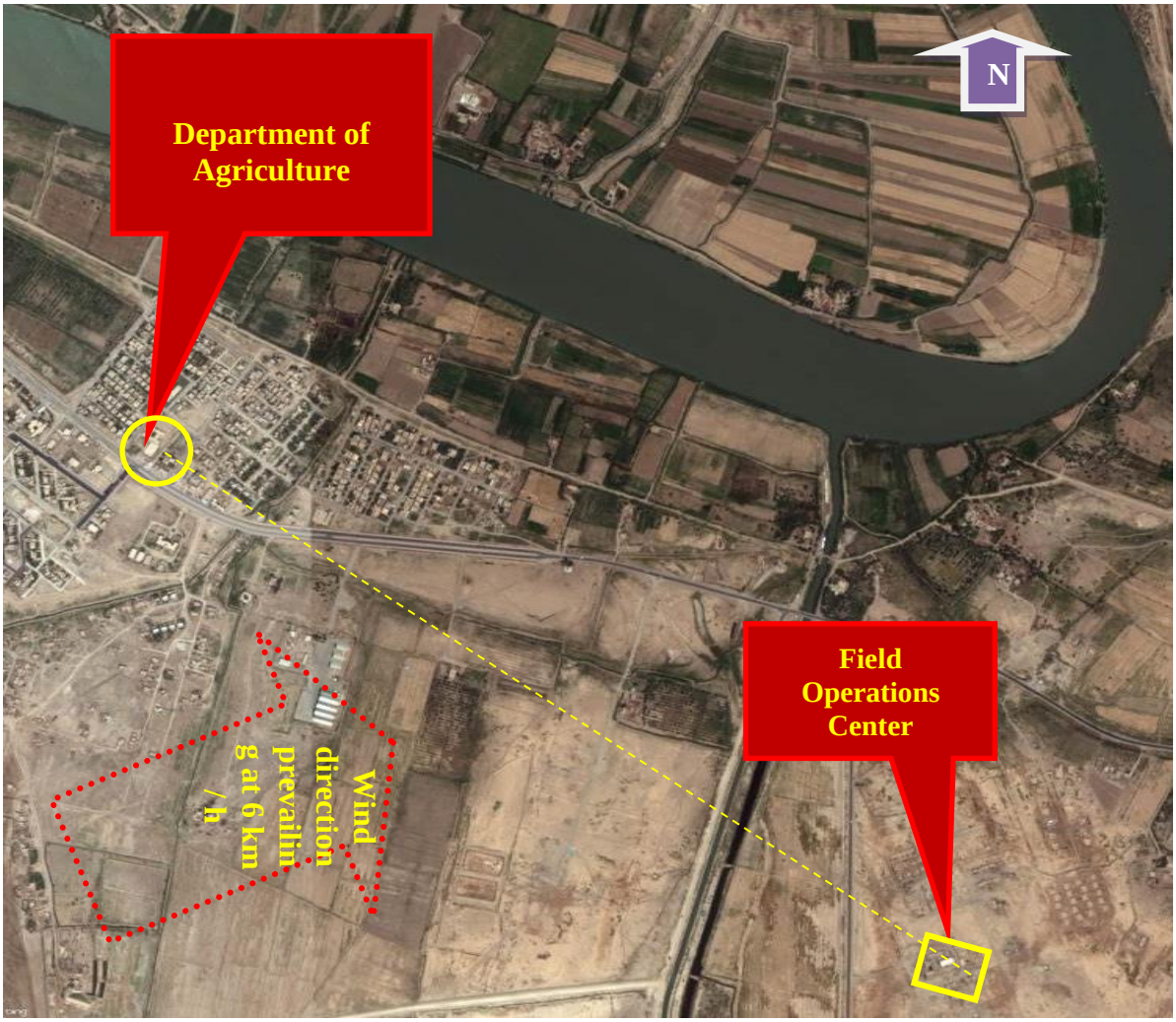

Figure 4. location of environmental data reading and field operations center.
Source. Based on aerial photos

Table 3. Results of ambient air readings in the urban center of Al-Ahrar (Department of Agriculture)

time	Co ppm	No ppm	No2 ppm	Nox ppm	NH3 ppm	O3 ppm	So2 ppm	H2s ppm	Co2 ppm	Temp °c
29/03/2018 10;00 am	0.2818	0.0017	0.0046	0.0063	0.0327	0.0223	0.0092	0.0026	355.3	29.65
29/03/2018 11;00 am	0.169	0.0011	0.003	0.0042	**0.0665**	0.0238	0.0054	0.0023	350.6	32.71
29/03/2018 12;00 am	0.124	0.0009	0.0026	0.0035	0.0407	0.0239	0.0048	0.0025	348.4	35.43
29/03/2018 13;00 pm	0.1287	0.0008	0.0014	0.0022	0.0351	0.0194	0.0035	0.0021	348.1	37.44
Iraqi determinants	**35**	**0.1**	**0.1**	**0.1**	**0.05**	**0.15**	**0.1**	**0.05**	**-**	**-**

Source: based on readings of the field car in the urban center of Al-ahrar, 12/3/2018

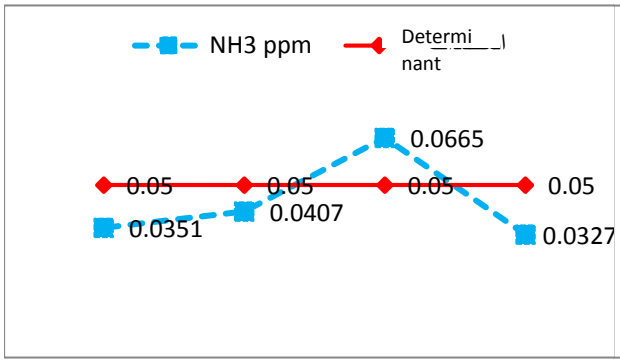

Figure 5. Representation of the results of readings outside the determinants. 2018 in the Al-ahrar

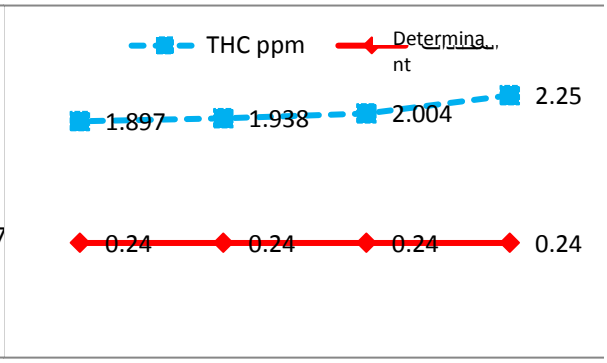

Figure 6. Representation of the results of readings outside the determinants 2018 in the Al-ahrar.

Source: Table (3).

The results of the data in Figure 5. and Figure 6. show that the values of NH3 and suspended hydrocarbons are more than determinants.

5. Noise

Sound is a ubiquitous part of daily life and it can originate from a seemingly limitless number of sources. Society tends to tolerate a certain level of sound before it becomes a nuisance, distraction or health hazard. When a sound is unwanted, interferes with speech or communication or causes the potential for hearing impairment, it is classified as noise [4]. Noise problems can be classified into two major categories; occupational noise and community noise. Separate standards regulate each type of noise category. Community noise is unwanted sound that occurs outside of the workplace. [5]A community noise problem is dynamic in nature and can result from a combination of sources potentially affecting a large number of individuals. According to the Housing and Urban Development's (HUD) annual housing survey, approximately one-half of the survey participants thought noise was a significant issue in their neighbourhood [6]

Central processing facility (CPF), oil wells, pumping sites and movement of machinery within the field are a source of noise. **Table 4**.

Table 4. Noise level reading data in five locations and at different times

locations	10\am	At 11 am	it's 12	1 pm	2pm
AN1	50	45.5	45	40.5	40
AN2	**55**	50.5	50	45.5	45
AN3	35.5	35	35	25.5	25
AN4	55	45.5	45	40.5	40.5
AN5	35.5	35	30.5	30	25
Determinants	Less than 55 in residential areas and less than 70 in industrial areas				

Source: Ministry of Oil, Central Oil Company Unpublished data.

5.1Potential impacts on surface water

There are usually three outputs of the oil well (oil, gas, and associated water). This water is associated with oil, known as Formation water or oilfield water. This water is usually described as highly saline, particularly sodium chloride [7].

There are a number of channels and projects within the study area, including: Husseiniya Canal, Al-Mazak Canal and some transit flows within the study area. The company withdraws 5000 cubic meters per day for drinking and firefighting in the central processing unit (CPF) Samples of surface water and from the sites shown in Table 5**.**

Table 5. Sites of water samples of the study area

Site	Water source	Icon	the location coordinates
Degla river	River water	W1	45.6319, 32.5167
Degla river	River water	W2	45.7931, 32.5382
Degla river	River water	W3	45.7285, 32.4453
Al Husseiniya channel	Ray Channel	W4	45.6423, 32.5372
Al Husseiniya channel	Ray Channel	W5	45.6116, 32.5432
Aboud Al Hussein	digging well	W6	45.6333, 32.4833
Al Mazak channel	Ray Channel	W7	45.7000, 32.4330
Al Mazak channel	Ray Channel	W8	45.7142, 32.4014
Naser	digging well	W9	45.7423, 32.4072

Source: Ministry of Oil, Central Oil Company, Al-Ahdab Field, unpublished data 2018

The places of drawing water are all within the boundaries of the oil field as shown in figure 7.

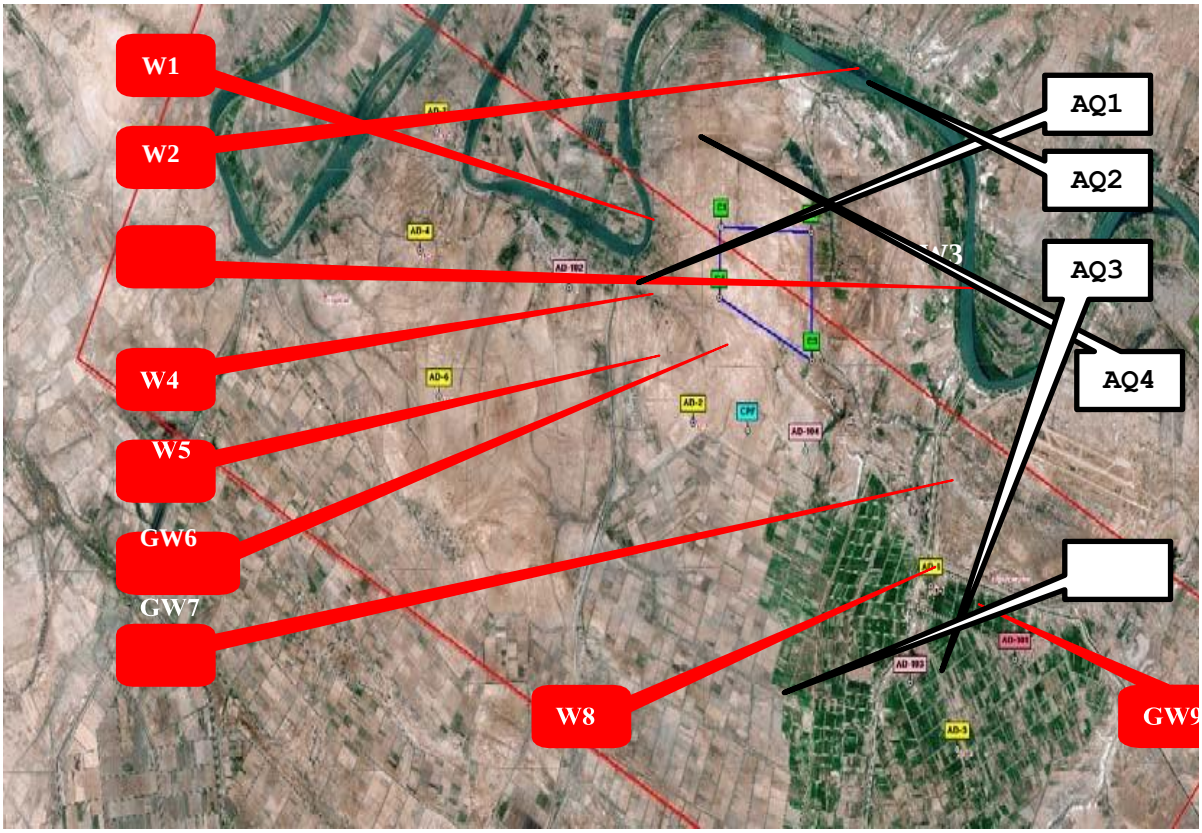

Figure 7. Water sampling sites in the study area

Source: Source: based on the satellite image

The surface water withdrawn from sites within and around the field was analyzed by the Central Oil Company and the results of the analysis were as in **Table 6.**

Table 6. Results of water sample analysis of the study area 2017.

Elements	W1	W2	W3	W4	W5	W6	W7	W8	W9	Iraqi standard
Temp (°C)	18.8	19.2	20.1	22.1	22.8	20.1	22.8	23.1	2	-
pH	7.6	8.1	7.9	7.8	7.9	8.2	7.7	8.4	7.8	6.5-8.5
EC (µs/cm)	822	922	986	543	565	212	442	315	154	400-600
TDS (ppm)	441	483	628	422	474	132	465	512	105	-
DO (mg/l)	8.2	7.7	5.2	4.3	4.2	3.1	5.8	7.7	3.9	>5
BOD5 (mg/l)	12.2	11.2	23.1	3.9	4.1	1.1	5.3	12.2	1.1	<5
COD (mg/l)	62.9	72.9	63.2	38.2	32.9	12.3	42.1	47.8	14.8	-
SO4 (mg/l)	550	742	623	421	488	221	287	386	292	200
NO3 (mg/l)	72.3	61.8	92.6	72.1	72.6	12.1	87.6	92.1	19.7	15
MPN	9.2	9.2	9.2	9.2	9.2	0	9.2	9.2	0	-

The values below the line are higher than the standards of Iraq

Source: Ministry of Oil, Central Oil Company, Al-Ahdab Field, unpublished data 2018.

- The analysis revealed that water quality was poor in many sampling sites, with high concentrations of soluble solids, nitrates and sulphates.

1. Soil examination results

The Central Oil Company has the results of samples of soil taken from the study area collected from six different locations close to the central processing unit (CPF) and three in different places as in **Table7.**

Table 7. Location of soil survey samples.

Soil sampling sites	Icon	the location coordinates
Aboud Al Hussein Village	S1	32.4833, 45.6333
Aboud Al Hussein Village	S2	32.4876, 45.5731
Aboud Al Hussein Village	S3	32.4864, 45.5273
Hussein Al Amer	S4	32.4667, 45.7167
Hussein Al Amer	S5	32.4324, 45.7432
Nasser Village	S6	32.4333, 45.7000

The results of soil sample readings were as shown in **Table 8.**

Table 8. Results of soil examination samples in and near the field of Al-Ahdab site.

Element	Site						minimum	Lower limit
	S1	S2	S3	S4	S5	S6		
mercury	BDL	BDL	BDL	BDL	BDL	BDL	0.3	10
arsenic	8.31	6.78	7.23	5.33	3.12	1.98	29	55
zinc	48.2	33.8	45.3	28.3	31.2	20.4	140	720
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL	1	20
Cadmium	1.1	2.3	1.1	0.6	1.4	1.8	0.8	12
chrome	46	52	37	72	63	56	100	380
Manganese	372	283	412	661	476	532	-	-
magnesium	38.2	23.5	17.5	72.8	51.4	48	-	-
copper	68.2	32.1	26.6	29.4	31.9	52.2	36	190
Tin	2.4	12.4	18.8	8.2	2.1	BDL	85	530
Nickel	42	37	14	523	318	432	35	210
iron	95.3	72.5	62.9	44.1	32.6	23.9	-	-
TPH*	17.9	19.9	18.1	12.2	14.6	18.2	-	-

**total petroleum hydrocarbons*

All units (mg / kg of matter), except TPH (µg / kg) .BDL = less than the detection limit The values written in bold override the Dutch target values, while the values written in a bold font override the Dutch interference values.

Source: Ministry of Oil, Central Oil Company, Al-Ahdab field studies, unpublished data 2018

The samples were analyzes of the minerals and total hydrocarbons. High concentrations of copper and nickel were recorded in some locations, so it is necessary to follow measures to reduce or mitigate soil impacts

In general, the potential impacts on soil are as follows:

- Spills due to leakage of crude oil, fuel and hazardous chemicals
- Mixing the products of soil drilling operations and using them for settling works for surface installations.
- Soil erosion and loss of vegetation cover by construction and civil workers.

The need to eliminate 400 tons / year of this type of mud from the drilling area, while in the production processes, the main source of pollution is the productive water that must be removed before the transfer of oil [8].

2. Questionnaire

Seventy-Four questionnaires were distributed to local government members in Wasit Governorate (a comprehensive survey), and at the three administrative levels, a provincial council, members of the local council of the Al - Nu'maniyah, and local council members Al - Ahrar.

The questionnaire was designed to measure the degree of acceptability about the environmental performance of the Al-Ahdab oil field. Table (9) shows the details of the questionnaire community and the invalid or incomplete forms.

Table 9. Number of the questionnaire community and participation rates in the questionnaire

Work site	the total number	Who completed the questionnaire	In complete
Provincial Council	28	20	8
Members of the Council of Nu'mania	24	22	2
Members of the local Council of the Al-ahrar	22	20	2
Total	74	62	12

6. The outcome of the questionnaire results

Answers were collected to evaluate the environmental sustainability of the study area, using the five Likert scale and the Cut of Point. The cut point of scale 1 to 5 is point 3.
for each question if the value is more than 3, the effect is negative, but if the value is less than 3, this means that there is a positive effect. Table 10. summarizes the responses.

Table 10. The responses of the questionnaire

Question	Type values	Strongly agreed	Agreed	Neutral	do not agree	do not agree strongly	Total	Weighted average	Type of impact
The seriousness of the company in protecting the environment	Real	5	8	14	21	14	62		negative
	Weighted	5	16	42	84	70	217	3.50	
The absence of liquids and oil ponds	Real	4	21	24	11	2	62		positive
	Weighted	4	42	72	44	10	172	2.77	
Change in surface water quality	Real	2	10	21	25	4	62		negative
	Weighted	2	20	63	100	20	205	3.30	
Feeling high noise levels.	Real	8	19	16	15	4	62		positive
	Weighted	8	38	48	60	20	174	2.80	
The project did not affect the decrease in agriculture land	Real	2	5	9	30	16	62		negative
	Weighted	2	10	27	120	80	239	3.85	
An effective emergency system.	Real	4	11	21	21	5	62		negative
	Weighted	4	22	63	84	25	198	3.19	
No pollution in soil and water	Real	3	12	20	21	6	62		negative
	Weighted	3	24	60	84	30	201	3.24	
Local air quality was affected by odors and emission of gases	Real	25	25	4	3	5	62		positive
	Weighted	25	50	12	12	25	124	2.00	
The company takes into account the investment of renewable energies	Real	6	5	18	21	12	62		negative

Table 10. shows that most of the environmental aspect of the project were negative from the point of view of the local community represented by the members of the local council, Qadaa Council and the Governorate Council. Their views were positive only in three cases: lack of notice of the presence of liquids and oil ponds, noise, and the local air quality due to odors and gases emitted.
We think the respondents did not feel the negative effects due to the large size of the site.

7. Conclusions

1. The main materials emitted during the drilling process are suspended particles, dust, nitrogen oxides and a sulfur oxides value has exceeded the Iraqi determinants in different locations of the study area.
2. There is general agreement in the society of the questionnaire that the management of the Ahdab oil field is not serious in avoiding the environmental effects.
3. There was no satisfaction in the local community with regard to the environmental situation of the study area in general, because of the direct effects suffers from, especially with regard to the shortage of agricultural land due to the project construction, and the negative impacts on soil and water.
4. The local community feeling no negative effects in three cases: lack of notice of the presence of liquids and oil ponds, noise, and the local air quality due to the large size of the site.

8. Recommendations

1. The need to include the principles of sustainable environmental development within the general directions of contracting whether field management is done by local companies or through contracting with the external partner.
2. Reducing the environmental impacts result from filed studies, and those who felt and suffered by the local community, whether those related to air quality, soil, and water surface.

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