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Impact of Oil Wells Drilling Process on Human Health in Hadhramout, Yemen

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Abstract

The aim of this study is to evaluate the effect of the oil well drilling process on human health in Hadhramout with emphasis on the following districts: Tarim, Sah, Gail Bin Yamin and Taribah. The number of oil companies have increased in Hadhramout and increased their petroleum activities, which in turn, have led to an increase in environmental pollution, especially water pollution, as a result of these petroleum activities. Water pollution has a direct impact on human health in areas close to the sites of oil activities, as well as having negative effects on public health of society specifically, the mortality rates and diseases have increased significantly and unnaturally in these areas. The study has been enhanced by questionnaire survey as a form of quantitative research; therefore this study will be conducted within the districts of Hadhramout governorate. In Hadhramout, most of waste oil is injected into the (geographical) Harshiyat formation which is a very close to the Mukalla formation which contains drinking water. Polluted water with waste oil, may unfortunately contribute in transmitting serious disease and conditions because it contains heavy metals and dangerous chemical substances which are toxic to the environment and water. Most of the Hadhramout residents consume their water from the Mukalla formation; consequently, the quality of water in the Hadhramout governorate has consistently strayed ever farther from acceptable standards, especially in the districts closest to the petroleum activities.

Keywords: Drilling Process, Underground Injection, Groundwater, Human Health, Hadhramout Governorate.

Introduction

Environmental problems occur in many countries due to their industrial development with their borders. Some of these problems have become a global catastrophe, as the earth is a single system, and any event occurring in one single remote location anywhere affects the system as a whole (Steffen, 2004). The petroleum industry had a negative impact on the components of the environment and community, and the oil wells drilling process is a part of the petroleum industry which a hole is bored into the earth to allow subsurface Hydrocarbons HCs to flow to the surface. In recent times, the number of oil companies have increased in Hadhramout and increased their level and degree of petroleum activities, which lead to an increase in environmental pollution especially water pollution as a result of these petroleum activities. Between 2005 and 2014, the cases of impact with diseases in Hadhramout Governorate are experiencing a very large increase such as cancer, kidney disease, and liver disease (Ministry of Public Health & Population, 2014), this study showed the main reason/es beyond increasing in cases of impact with diseases in Hadhramout. The oil production blocks in Yemen until the end of 2012 reached to as high a number 13 blocks from an absolute total of 105 blocks according to the recent oil concession map. All production blocks are produced from only two main sedimentary basins; the (*Marib-Shabwah*) basin and (*Say'un-Masila*) basin which located in Hadhramout governorate (Ministry of Oil and Minerals, 2017) as shown in Figure 1, while there are 12 sedimentary basins present in whole Yemen.

Figure 1: Main sedimentary basins in the Republic of Yemen (Hakimi, Al Qadasi, Al Sharrabi, Al Sorore, & Al Samet, 2017)



The oil well drilling process generates a different of wastes such as drill cuttings, drilling fluid and water associated with oil (produced water), most of waste is disposed of by re-injection it into the underground (Whitaker, 2014). In Hadhramout governorate, waste oil is injected into Harshiyat formation which is a very close to Mukalla formation which contains drinking water (Al-Hebshi & Rabaa, 2007). Polluted water with waste oil, may unfortunately contribute in transmitting serious disease and condition, such as cancer, kidney disease, liver disease because

it contains heavy metals and dangerous chemical substances such as cadmium, chromium, lead, mercury Iron, manganese, chromium, copper and other elements which are toxic to the environment and water (Bircher, 2005). The quality of water in the Hadhramout governorate has consistently strayed ever farther from acceptable standards, especially in the districts closest to the petroleum activities because most of the Hadhramout residents consume their water from the Mukalla formation (Al-Hebshi & Rabaa, 2007).

The average oil production of Yemen is 450,000 barrel of oil per day (BOPD) and Hadhramout contributes more than half of this total, with an annual average production of about 230,000 BOPD (King, 2003). The biggest production challenges in Hadhramout fields are the handling of water associated with the resulting oil which may hereafter be called produced water. Much of this water is produced along with the oil because of a combination of medium-gravity (158–338 API) moderate, viscosity level of the extracted oil, high reservoir permeability, and a strong regional aquifer (As-Saruri, 2014; Halbouty, 1990). Produced water is water trapped in the underground formation that is brought to the surface along with oil or gas (AlAnezi, 2013; Mumford, 2015). It is by far the largest volume by-product or waste stream associated with oil and gas production. The management and processing of produced water and its environmental effects constitute serious challenges to the relevant officials in the oil industry and environmental experts. It is established that the composition of produced water is complex and varies widely potentially containing toxic substances. This water has been in contact with the hydrocarbon-bearing formation for centuries, and as a result, contains some of the chemical characteristics of the given formation and the hydrocarbon itself.

Waste oil contains chemical elements such as: zinc, copper, barium and cadmium (Bircher, 2005). These chemical elements have serious environmental effects represented in water pollution, soil, land, and disturbance of the ecosystem, therefore the impact on public health and spread diseases, of the affected-the Hadhramout population is 1,367,000 Between 2005 and 2014 are noted a significant increase in morbidity (Ministry of Public Health & Population, 2014).

Literature Review

Oil and gas exploration and production are associated with many environmental and socioeconomic impacts (Baptiste, 2009). Despite this, many nations throughout the world would still be driven to promote the discovery of oil and gas within their countries. All the activities involved in the hydrocarbon exploration and production - normally have one impact or the other on the environment (Odieta, 2003). However, the greatest impact arises from the release of wastes into the environment in concentration that is not naturally found in such an environment, an increase in drilling ultimately leads to an increase in becoming exposed to waste products. This indicates that the drilling operations and waste resulting from them are directly proportional, which leads to increased environmental pollution and its direct impact on human health. The World Health Organization (WHO) defines health as a state of complete physical, mental and social wellbeing and not the mere absence of disease or infirmity (Bircher, 2005). This definition gives a holistic dimension to the issues concerning the health of

individuals as well as whole communities. It provides a template for defining various dimensions to health and its determinants, the oil contamination, occurring in the water, on land, and in the air, and how all of these various factors have affected different aspects of people's health. The health impacts of exposure to drilling waste resulting in the following:

- Aromatic hydrocarbons, including heterocyclic chemicals that can mimic hormones,
- Bactericides,
- Soluble chromates,
- Mercury and other heavy metals,
- Corrosion inhibitors, and
- Naturally Occurring Radioactive Materials (NORMs) commonly found in underground geologic deposits and frequently brought to the surface during the drilling of an oil well.

Masila Basin is one of the onshore basins in Yemen, which is located in the eastern part of Yemen (Hadhramout) and has 7 production blocks from 13 production blocks in Yemen as shown at Table 1 (Ministry of Oil and Minerals, 2006). The Masila basin is classified as large hydrocarbon basins in Yemen and contains several, well-known hydrocarbon oilfields. Nowadays, petroleum companies increased in Hadhramout such as PetroMasila, Total, Calvally, Dove and DNO which are operating in different oil blocks such as Maslia14, East Shabwah10, Malik9, East Saar53 and Hawarim32 as shown in table 2.1, therefore increased their petroleum activities which lead to an increase in environmental pollution especially water pollution as a result of these petroleum activities. In recent times, the number of diseases and deaths caused by cancer, kidney disease, liver disease and others have increased abnormally in Hadhramout (Hadhramout Cancer Foundation, 2017; Ministry of Public Health & Population, 2014). The biggest petroleum production challenge is water handling, as much water is produced along with the oil in most of the actively operating blocks of potential Yemeni oil reserves blocks because of a combination of medium-gravity (158–338 API) moderate viscosity of oil, high reservoir permeability, and a strong regional aquifer.

Table 1: Location of oil production blocks in Yemen (Ministry of Oil and Minerals, 2006)

Block Name	Governorate	Operator	Area (km2)	Start Year
Marib 18	Marib	Safer E&P operation	8,479	1986
Masila 14	Hadhramout	PetroMasila	1,257	1998
East Shabwah 10	Hadhramout	Total E&P Yemen	964	1997
Jannah 5	Shabwah	Jannah Hunt	280	1996
East Saar 53	Hadhramout	DOVE Energy	447	2001
Hwarim 32	Hadhramout	DNO	592	2000
Damis S1	Shabwah	Occidental	1,156	2004
East Al- Hajr 51	Hadhramout	Canadian Nexen Yemen Ltd	2,004	2004
South Hwarim 43	Hadhramout	DOVE	1,622	2005
Malik 9	Hadhramout	Calvally	2,227	2006
W. Ayad 4	Shabwah	KNOC	1,998	1987
Al- Uqlah S2	Shabwah	OMV	904	904

For example, the Masila block14 oil-production operation might be more accurately described as a water production operation with an oil by-product. At the year-end of 2000, the total annualized daily oil production was 230,000 BOPD, with associated produced water of 725,000 BWPD equal to 76% of total fluid production. Most of the produced water is re-injected or disposed of into the upper Qishn sandstone S2 or S3 reservoirs, and eventually ends up directly into Harshiyat formation, which contains potable water (refer to Figure 2 & Table 2), with a small volume of water injected into other producing reservoirs to enhance the oil production. Disposal of this water is routinely and periodically re-injected into the ground or by any other ways that negatively affect groundwater, soil, and human health, and it consequently disrupts the ecosystem (Pruden, 2013; Winther, 2013).

Figure 2: Stratigraphic column in the Masila Basin (Hakimi et al., 2017)

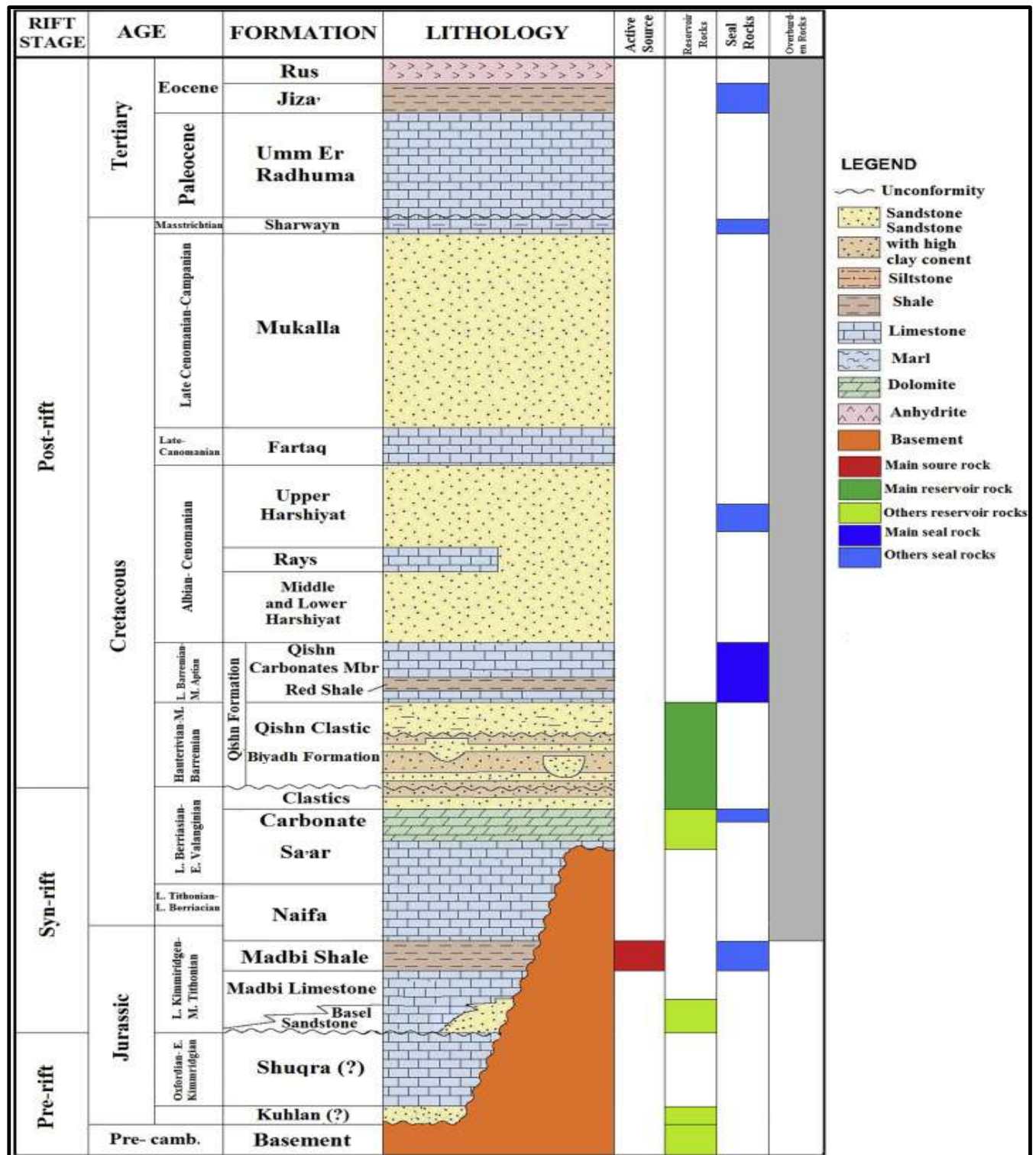


Table 2: Typical Rock Formation in Masila Block Hadhramout (Al-Hebshi & Rabaa, 2007)

No	Aquifer	Aquifer depth by mater	Water by the Millions barrel in a squire mail	Water quality
1	Mukalla	300-600	640	Potable
2	Harshiyat	700-900	742	Potable
3	Qishn	-	96	Water & oil

Actually, produced water is one of the waste oil by-products that creates on chemical elements, and thus re-injection of it into the Harshiyat formation which happens to be close to Mukalla formation containing drinking water used by most of the residents in Hadhramout be threat on human health. Waste oil contains on chemical elements such as: zinc, copper, barium and cadmium (Bircher, 2005); (Sadoughi & Hesampour, 2017), these chemical elements have serious environmental effects represented in water pollution, soil, land, and disturbance of the ecosystem, therefore the impact on public health and spread diseases. Hadhramout governorate, which has a large number of oil companies and is located near populated areas such as Gail Bin Yamin, Sah, Sharuff, Sounna and others, the Hadhramout population is 1,367,000 between 2005 and 2014 are noted a significant increase in morbidity (Ministry of Public Health & Population, 2014), as shown in Table 3:

Table 3: Comparison between the cases in 2005 and 2014 in Hadhramout (Ministry of Public Health & Population, 2014)

Diseases	No. of cases in 2005	No. of cases in 2014	Diseases	No. of cases in 2005	No. of cases in 2014	Diseases	No. of cases in 2005	No. of cases in 2014
Skin diseases	458	9,913	Cancer	323	1,133	Liver disease	299	912
Diseases of the digestive system	12,430	24,609	Pregnancy complications	5	768	Diseases of the respiratory system	279	27,435
Anemias	9,462	18,183	Diseases of the eye & adnexa	11,748	11,387	Hypertensive diseases	8,643	14,484
Diarrhea non-Bloody	11,250	31,507	Diarrhea Bloody	620	5,620	poliomyelitis	47	576
Diseases of spleen	64	128	Urticaria and Erythema	1,447	2,987	Urolithiasis	398	1,448
Gastric ulcer	1,026	4,454	Kidney disease	87	312	Fever	2,488	6,054
Diseases of the oral cavity	765	2,622	Colic	714	3,215	Muscle paralysis	47	4,813
Diseases of the nervous system	456	977	Cardiovascular disease	1,120	4,685	Bacterial Foodborne intoxication	181	1,433
Chronic rhinitis nasopharyngitis	5,789	11,202	Diseases of the genitourinary system	1,020	25,957			

The cases of impact with diseases in Hadhramout Governorate are experiencing a very large increase, which focuses attention on oil companies and their activities, as there is a significant increase in the number of people with cancer or related symptoms and developments, such as tumors, colon, and blood inflammation, as the rate of high incidence of these diseases between 2007 and 2013 about 100 new cases in the year, the number of cancer deaths in 2017 was 151 cases out of a total of 604 cases compared to 107 deaths in 2012 (Hadhramout Cancer Foundation, 2017). As noted in the areas of Gail Bin Yamin and Sah some environmental effects,

when the people of these areas wanted to drill drinking water wells and were surprised by the unexpected appearance of the oil waste, which rose to the surface as shown in Figures 3.

Figure 3: Some of the pollution impacts in targeted districts,2018



We conclude from these data that the oil well drilling processes and petroleum activities in general by the oil companies in Hadhramout governorate pose a direct threat to human health and the ecosystem in general, through the disposal of the waste oil, where they are re-injected it in inappropriate formations (Harshiyat formation) and very close to the formations containing drinking water (Mukalla formation).

Methodology

This study was designed to evaluate the impact of the oil well drilling process on human health in Hadhramout - Yemen. The study has been achieved by conducting a literature review and questionnaire survey as a mode of quantitative research, therefore this study was conducted within the districts of Hadhramout city. Targeted places, which include four main districts of the city namely Tarim, Sah, Gail Bin Yamin and Taribah, where each district is considered as one of those potentially vulnerable communities, due to their juxtaposition with the Hadhramout water stream. The other targeted place is a local community which is related to this problem. Therefore, the study was determined to measure the effect of waste oil that includes produced water, drilling cutting and drilling fluid on potable water in the area around the Hadhramout fields and thus a negative effect on human health. The researchers distributed the questionnaire to respondents within targeted places to find reliable and adequate information about the impact of waste oil resulting from petroleum activities on groundwater and public health in those communities. These respondents came from different areas in Hadhramout and totaled 122. Most of the respondents came from areas close to petroleum activities such as: Sah, Ghail Ben Yamin, Tarim and Tarabah. Data were analyzed quantitatively using (SPSS) version 16.0 including descriptive and inferential statistical tools.

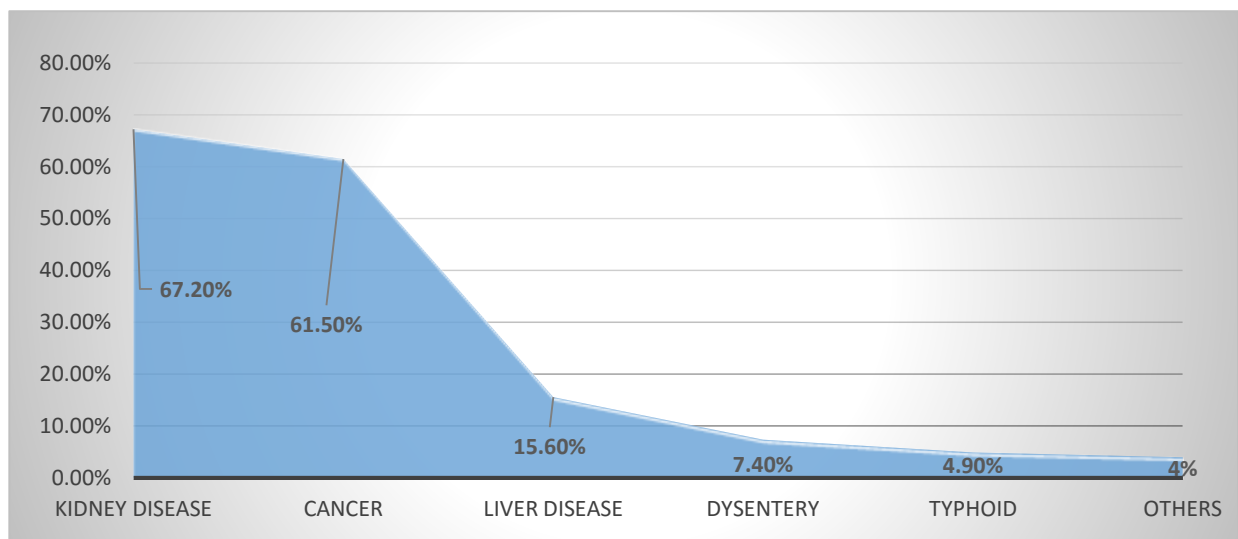
Results and Discussion

The target respondents of the questionnaire survey were people who live in four districts (Tarim, Sah, Yamin, and Taribah) because within these districts existed numbers of petroleum

companies. Also, some people from other surrounding cities which happen to be located in the Hadhramout governorate. This section analyzed the demographic data of the 122 respondents. Among the respondents, 33.6% were from the Tarim district, while 23.8% were in the Sah district and 9% in Gail Bin Yamin district. However, the small percentage was 5% in Taribah while 27.9% emanated from different districts in Hadhramout. With regard to gender distribution of the questionnaire survey 95.1% were male while 4.9% were female. In case of the age, the highest rate was 57% for ages 25 to 35 years, 20.9% were 35 to 45 years of age and from 10 to 25 was 19.7%, 1.6% were 45-55 years of age while the least significant percentage was 0.8% for those respondents aged 55 years of age and above.

Around the world more than 2 million people die each year from diseases such as cholera, typhoid, and dysentery that are spread by polluted water or by a lack of water for hygiene (Abdirahman, 2015). Thus, figure 4 illustrates the most common diseases which are related to polluted water in four districts selected in Hadhramout governorate. According to the Hadhramout Cancer Foundation for 2017, the number of cancer deaths in that year was 151 cases out of a total of 604 cases compared to 107 deaths in 2012 in Hadhramout. Moreover, the numbers of cases which involved liver diseases and kidney diseases had risen between 2005 to 2014, according to the Ministry of Public Health & Population in Yemen. In Hadhramout, Yemen, 42% answered that kidney diseases are the most common disease of their district, 38% also answered that cancer is the common disease in their area while 10% were liver diseases and 5% were dysentery disease is the common disease in their district and 3% were typhoid disease, finally the rest of the respondents 2% chose different diseases.

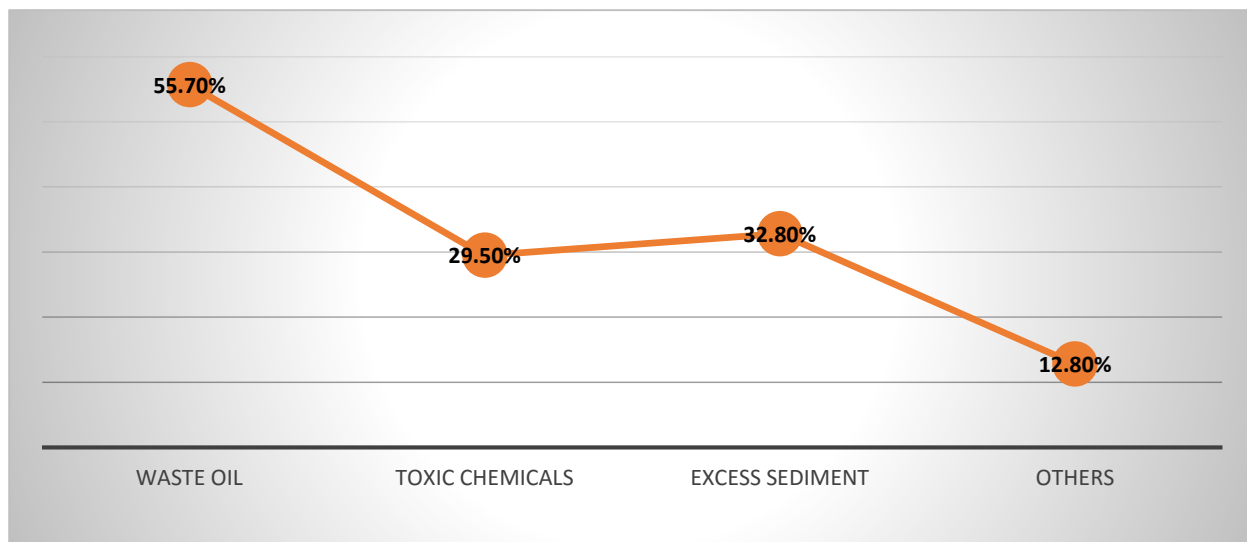
Figure 4: The most common diseases related with polluted water



There are three major causes of water pollution in the targeted districts in Hadhramout governorate. Thus, they have an effect on human health and lead to spread diseases between people who live near a petroleum activity. Most of the respondents (52%) believe that the

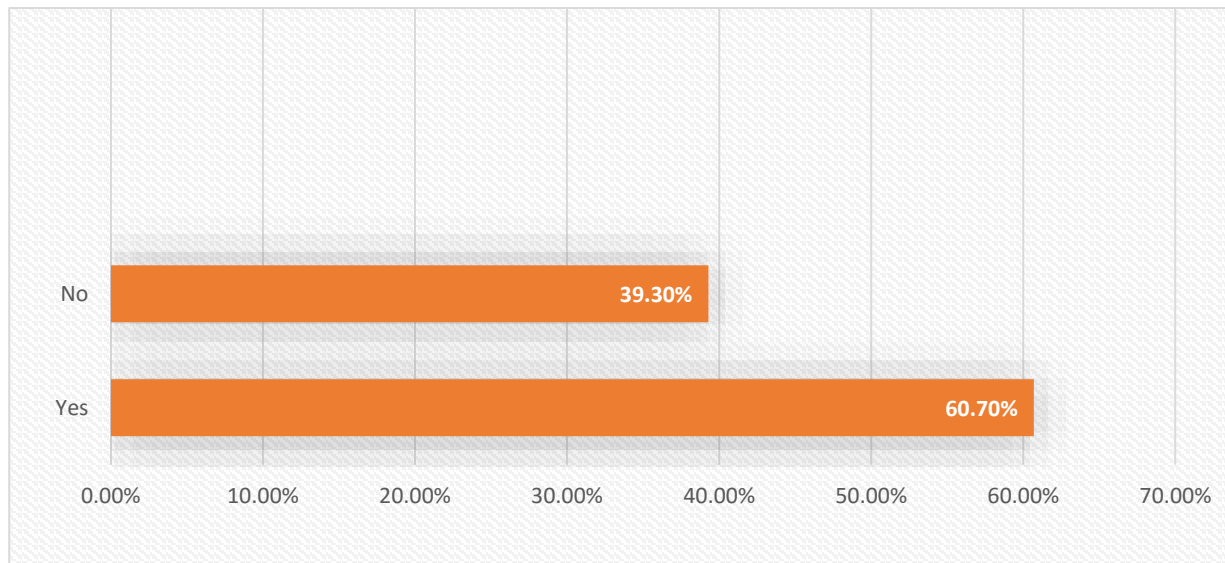
waste oil is the main reason for water pollution in their districts and thus directly affects their health. The proximity of oil companies to places of living (a few kilometers away) and non-compliance with international and local standards for the disposal of waste oil leads to damage to the environment and human being (Al-Hebshi & Rabaa, 2007; Al-Mashjari, 2013; Rabi, Ghazali, Rohaizad, & Zulkefli, 2018; Abazeed, 2018). Excess sediment 29% was the second most significant reason for water pollution in Hadhramout state according to respondents while 25% listed toxic chemicals as the third largest water pollutant, 9% mentioned other pollutants such as sewage.

Figure 5: Major causes of water pollution in Hadhramout-Yemen



The kidney is one of the most important organs in the human body. Like all internal organs, it can be adversely affected by some of the heavy and chemicals metals that are found in the water and air. According to the Ministry of Public Health & Population in Yemen, the cases of kidney disease shot up from (87) in 2005 to (312) in 2014. Children are more prone to disease because of their weakened immunity and non-resistance to diseases when compared to older people who have a comparatively stronger level of immunity. So that in my study area, (39.3%) of the respondents were confirmed that there are no kidney problems with their children, while the rest (60.7%) had kidney problems with their children.

Figure 6: Children who had kidney problems in the past year



Impact of Water Pollution on Public Health

There was a section contains 4 items of the relationship between water pollution and public health. These items were subjected to the views of the respondents and were analyzed. The Descriptive Statistics, i.e. Means, Standard Deviations (SD), and finally ranks were established and presented in Table (4):

Table 4: Level of water pollution impact on public health

Code	Items	Mean	SD	Rank
1	What type of water do you prefer?	1.51	0.826	3
2	Do you think the water which you drink is good quality?	3.28	1.062	1
3	How often do you clean your drinking water tank?	1.75	0.624	4
3	Does water sometimes smell like rotten eggs?	2.82	1.128	2

The findings indicated that “Do you think the water which you drink is good quality?” with (Mean= 3.28; SD= 1.062) received the highest rank of importance, according to the overall impressions of the respondents. Quality drinking water is the most important element to our well-being and health. People always use water daily in our homes for cleaning, cooking, bathing, laundry and a host of other purposes. In response to this question most, people think that the water they drink is of high quality because they depend on drinking mineral water; on the other hand, they do not know the standards of drinking water quality.

“Does water sometimes smell like rotten eggs?” with (Mean= 2.82; SD= 1.128) got the second rank. If the water smells like rotten eggs, it may be polluted with hydrogen sulfide (H₂S), Hydrogen sulfide is a broad-spectrum poison; it can poison various organs within the human

body, and the nervous system remains the most affected. The toxicity of hydrogen sulfide can be compared with carbon monoxide and hydrocyanic acid. The negative health effects, when exposed to this gas, are shortness of breath, nausea, headache, and may lead to heart attacks in the case of exposure to higher rates of it (Pubchem, 2018). Hydrogen sulfide is found in different proportions, but it is found in high percentages in both oil and natural gas. This confirms the possibility of this region being exposed to oil pollution of its groundwater.

“How often do you clean your drinking water tank?” with (Mean= 1.75; SD= 0.624) was ranked as the 3rd most important health priority position. Although the water delivered by pipe or tanker has been treated, cleaning out the sediment and disinfecting the household water storage tank at least once a week is necessary suspended material in the tank as it may be toxic also to maintain family health.

“What type of water do you prefer?” with (Mean= 1.51; SD= 0.826) placed fourth in important for the group of respondents interviewed. Drinking water is water that is safe and clean for people to drink. currently, there is an increasing trend in consumers who prefer mineral water over tap water and the town supply of water because mineral water is cleaner and safe than other water according to respondents in this study, 70.5% preferred mineral water while 21.3% preferred tap water and the rest 8.2% preferred dams' water.

Conclusion

The human health in the Hadhramout governorate is not good especially in the districts which are geographically near of the petroleum activates because non-compliance of the petroleum companies with matters of environmental safety and use unsafe and illegal ways to dispose of the oil waste. In the Hadhramout oil fields, quantities of water associated with oil during the production process or so-called produced water are very huge and its disposal as waste is a major challenge for oil companies. Waste oil including drilling cutting, drilling fluids and produced water are disposed by re-injected into the Harshiyat formation, which is very close to the Mukalla formation that contains drinking water. Most of the residents in Hadhramout use their water from the Mukalla formation which is polluted with heavy metals and toxic components. Thus, polluted water has directly negative effects on human health also; it leads to the spreading of many diseases such as cancer, kidney disease, liver disease as a result of the presence of heavy metals and toxic elements in the drinking water as a result of pollution by waste oil. Consequently, the quality of water in the Hadhramout governorate has consistently strayed ever farther from acceptable standards, especially in the districts closest to the petroleum activities.

The study has a contribution to both academic and practice. In the first place, this study will contribute knowledge by extending the understanding of petroleum activities impact on human health a different perspective. The study will reveal the current situation of petroleum activities in Hadhramout, Yemen and its effect on public health. Moreover, the study will complement the lack of petroleum activates research at the appropriate level. Besides that, the study will also surpass the knowledge of oil wells drilling process challenges. In addition, this study outlines factors to ensure good health for human and also provides strategic plan to overcome

challenges. Secondly, the study will contribute to the practice by recommending a useful key success factors that could establish positive changes in oil wells drilling process among players in oil fields in Hadhramout. On top of that, the study will increase the growth in awareness between people in Hadhramout, Yemen.

References

- Abazeed, R. A. M. (2018). The Impact of Talent Management on Organizational Commitment of the employees of telecommunication companies in Jordan: The Mediating Role of Employee Work Engagement, *International Journal of Academic Research in Accounting, Finance and Management Sciences* 8 (4): 153-162.
- Abdirahman, M. Y. (2015). *Effect of Water Pollution on Public Health*.
- Al-Hebshi, M., & Rabaa, S. A. B. (2007). *TRADITIONAL WATER HARVESTING SYSTEMS AND MANAGEMENT IN WADI HADHRAMOU YEMEN*. Paper presented at the The 4th Asian Regional Conference & 10th International Seminar on Participatory Irrigation Management-Tehran-Iran May 2-5, 2007.
- AlAnezi, K., Belkharchouche, Mohamed, Alali, Sabah, Abuhaimed, Waleed. (2013). Produced water characterization in Kuwait and its impact on environment. *Desalination and Water Treatment*, 51(1-3), 302-306.
- As-Saruri, M., Sorkhabi, Rasoul. (2014). Petroleum systems and basins of Yemen.
- Baptiste, A. K., Nordenstam, Brenda J. (2009). Impact of oil and gas drilling in Trinidad: factors influencing environmental attitudes and behaviours within three rural wetland communities. *Environmental Conservation*, 36(1), 14-21.
- Bircher, J. (2005). Towards a dynamic definition of health and disease. *Medicine, Health Care and Philosophy*, 8(3), 335-341.
- Hadhramout Cancer Foundation. (2017). Hadhramout Cancer Foundation,2017.
- Hakimi, Al Qadasi, B. A., Al Sharrabi, Y., Al Sorore, O. T., & Al Samet, N. G. (2017). Petrophysical properties of Cretaceous clastic rocks (Qishn Formation) in the Sharyoof oilfield, onshore Masila Basin, Yemen. *Egyptian journal of petroleum*, 26(2), 439-455.
- Halbouty, M. T. (1990). Giant oil and gas fields of the decade.
- King, W., Mills, B. R., Gardiner, Scott, Abdillah, A. A. (2003). The masila fields, Republic of Yemen.
- Ministry of Oil and Minerals. (2006). *Oil blocks in Yemen*.
- Ministry of Oil and Minerals. (2017). from <http://www.yemen.gov.ye/portal/default.aspx?tabid=280>
- Ministry of Public Health & Population. (2014). Ministry of Public Health & Population.
- Mohammed Al-Mashjari. (2013). Field Access Report to Sector 34 of Gail Bin Yameen Subsidiary of DNO.
- Mumford, K. A., Wu, Yue, Smith, Kathryn, H., Stevens, Geoffrey, W. (2015). Review of solvent based carbon-dioxide capture technologies. *Frontiers of Chemical Science and Engineering*, 9(2), 125-141.
- Odiete, W. (2003). Standardization of test animals for toxicity evaluation for Environmental regulation in Nigeria. *J. Nig. Environ. Soc*, 1(3), 340-350.

- Pruden, A., Larsson, D. G., Joakim, Amézquita, Alejandro, Collignon, Peter, Brandt, Kristian K, Graham, David, W., Lazorchak, James, M., Suzuki, Satoru, Silley, Peter, Snape, Jason, R. (2013). Management options for reducing the release of antibiotics and antibiotic resistance genes to the environment. *Environmental health perspectives*, 121(8), 878-885.
- pubchem. (2018). hydrogen sulfide. from pubchem.ncbi.nlm.nih.gov
- Sadoughi, M., & Hesampour, F. (2017). The Relationship between Perceived Social Support and Loneliness among University Students. *Multilingual Academic Journal of Education and Social Sciences*, 5(1), 1–6.
- Rabi, N. M., Ghazali, N. H. C. M., Rohaizad, N. A. A., & Zulkefli, M. Y. (2018). Readiness of PreService Teacher to teach Student with Special Needs through Inclusive Education Course. *International Journal of Academic Research in Progressive Education and Development*, 7(4), 200–210.
- Steffen, W., Sanderson, A., Tyson, P. D. (2004). Jä ger J, Matson PA, Moore III B, Oldfield F, Richardson K, Schellnhuber HJ, Turner BL (Eds): et al.: *Global Change and the Earth System. A Planet under Pressure. Berlin: Springer.*
- Whitaker, A. H. (2014). *Land Application of Drilling Mud from Oil and Gas Exploration: Agronomic and Environmental Implications.* Oklahoma State University.
- Winther, P. T. (2013). *Environmental Management in the Petroleum Industry: Sustainability, Global frameworks and Management tools.* Institutt for industriell økonomi og teknologiledelse.