



## The effects of petroleum wastes in water and local environment in Melut and Maban Counties - Upper Nile State- South Sudan

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### Abstract

This study was aimed to investigate the effects of petroleum waste in wastewater and local environment in Melut and Maban Counties in South Sudan. Population of the study is 30,000 people. 265 respondents were selected randomly as a sample of the study. Variables were, wastewater status of citizen, health and effects on the local environment. Data were collected through survey, involving (primary data) which were collected by using questionnaire and (laboratory data) which were collected from waste water in three locations. (SPSS) was used for primary data analysis by using descriptive statistics, while for the laboratory data, Atomic absorption Spectroscopy (AAS700) was used for detecting Hg, As, Pb, Fe and Mn elements levels in wastewater samples. Findings of the primary data showed 94.1% of residents' respondents noticed the decrease of rains in the study area and 65.9% of them noticed the decrease of temperature. 86.2% of public health employees respondents reported defections of newly born children, 93.8% of them reported infant's mortality. 90.8% of them reported infertility infections. 75.4% of them reported eyes and skin allergy infections and 66.2% of them reported teeth decay and hair falling infections. 67.7% of the national resource's employees' respondents noticed animals drink the wastewater and 83.1% of them reported the death of birds around the petroleum pits. while the laboratory data indicates presence of (Hg, As and Pb) in higher levels compared to the normal international allowed one in wastewater, and the level of (Fe and Mn) were lower. Recommendations are includes avoiding using wastewater near the

petroleum wells, treatment of the wastewater for human and animals using and Petroleum companies must abide to the rules of the petroleum work and they have to contribute in the development of local community and awareness.

**Key words:** petroleum wastes, water, local environment, Upper Nile, South Sudan

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## Introduction

South Sudan is a very rich country of natural resources such as; forestry, pasture, wildlife and domestic animals, soils, water, oil and minerals ...etc. Water is a vital element for the life of human being, animals and plants. (Water is the main constituent of the blood which functions as the carrier of nutrients in bodies to every cell, in the process water helps the organ to absorb the required nutrients). It also aids in the circulation of oxygen in our blood. Water enables hydrolysis reaction thus biochemically breaking down whatever eaten,[1]. So, any pollution of water will affect negatively the human health that allowable rates for heavy metals that may mixed with drinking water are 10mg.L<sup>-1</sup> for Hg, 5mg.L<sup>-1</sup> for As, 0. 48mg.L<sup>-1</sup> for Pb, (25-30) mg. L<sup>-1</sup> for Fe and 2. 3mg.L<sup>-1</sup> for Mn. It is important to notify that this wastewater under the study is not for human drinking but sometimes animals may drink it. The study used the WHO standards permissible value for drinking water, considering HPI which represents the total quality of water with respect to heavy metals, it is calculated by assessing a weight-age ( $W_i$ ) for individual parameter which is a value between (0 and 1) reflecting the relative importance of the individual quality consideration. So, the HPI was calculated using the following equation.[2], [3], [4].

$$HPI = \frac{\sum_{i=1}^{i=n} (Q_i \times W_i)}{\sum_{i=1}^{i=n} W_i}$$

Where:

HPI = heavy metal pollution index.

$Q_i$  = sub index of the  $i$ th parameter.

$W_i$  = unit weight of the  $i$ th parameter.

$n$  = number of parameters considered; the sub index ( $Q_i$ ) of the parameter is;

$$Q_i = \frac{V_i}{S_i} \times 100$$

Where:

$V_i$  = value of metal of  $i$ th parameter.

$S_i$  = the standard value.

The HPI value of drinking water less than 100 is classified as suitable for drinking. [5].

The environment was completely neglected because of political conflicts in South Sudan. In 2007 hydrocarbons accounted for over 95 presents of Sudan and South Sudan income. Activities of oil production is one of the environmental problems that cause damage to humans, animals and plants in South Sudan, areas that have become polluted by mixing hydrocarbon and organic materials with heavy metals. Communities have also been ringing the alarm bell about pollution and health hazards caused by the petroleum waste. Weak or completely absence of regulations affected environmental conditions prior to independence [6]. Petroleum Wastewater causes indirect environmental effects such as deforestation,

poaching added to the misery, estimated that 180,000 people face threatening risks of oil wastes heavy metals leaking, pipelines and refineries and damage from war [7]. Though no comprehensive study of the environmental impact has been conducted, a note that "the war has worsened environmental conditions as some oil fields have been abandoned without cleaning up of leakages and spills and the conflict has made defaults to prioritize South Sudan-based. [8]. There are strong indicators that toxic wastewater, drilling mud's, found in oils spills, and chemicals have seriously polluted the environment. Communities living near oil fields have flagged concerns over health problems. According to medical staff in some of these oil-rich areas, "communities are not made fully aware of hazards associated with the production of oil." The authority is unable and perhaps unwilling, to hold oil companies accountable or provide capacity. Foreign companies have been unhelpful to say the least as peace demonstrated,[9]. Thought the 2012 Petroleum Act required setting up funds to repair environmental damage and pay reparations to affected communities, there is are little evidence according to the Sudd institute and pax. Companies were addressing environmental health risks is a way to demonstrate legitimacy severe damage to ecosystem that communities depend on the basic need can have affected the environment, [10]. More importantly, the voices of affected communities should be at the forefront of stakeholder discussions when rebuilding war-torn societies understanding their grievances and concerns of building back healthier and more peaceful societies, [11]. The team also identified positive side effects of the oil business, such as: free access to roads constructed by the companies' Chemical tank used for water, Paloch, [12]. Main Objective of the study is to study impact of oil excavation on the

environment in area while the specific objectives were; to determine the effect of petroleum waste on water in the study area, to investigate toxin of the petroleum wastes on human, animal and plant in the study area and to detect health hazards that caused by petroleum wastes on human and local residence in the study area.

### **Materials and Methods:**

#### **Study area :**

Melut (Paloch) line between (Latitude 10. °26 N, longitude 32. °12, E and Maban latitude 9. °94 N, Longitude 33. °61 E. Residents predominantly are Dinka and Maban. Villages in these areas would typically count between 450 and 950 inhabitants. It is also characterized by sunshine for long periods during the year with high temperatures. The rainfall is mid-June. Extremes of temperature, on average, are low in January, is about 28 °C rising to 41°C in April and May [13]. Melut County is one of 13 counties in Upper Nile State; it is situated on the eastern bank of the White Nile and residents about 50000 individuals with 35% of them live within Paloch near of the oil field and 65% lived within Melut and others villages areas. The second County is Maban (Adar Yale) with population about 53000 individuals which is 25% live within or near of oil field and 75% live in further areas around Adar Yale .

#### **Population of the study :**

Melut and Maban counties are two counties of the 13 counties of the Upper Nile State. Melut composed of five administrative units while Maban is composed of five administrative units. Paloch, Adar Yale and Gumry were selected from the two mentioned counties to represent the study area. Population of the study area is around 30000 residents (17000 in paloch and 13000 in Adar Yale and Gumry) .

### Sample of the Study :

Sample of the study was composed of 265 respondents, selected randomly from the study area as follows; (135 from residents, 65 from employees of public health and 65 from employees of natural resources) .

### Data collection :

Two types of data were collected for this study, the first was primary data in which detailed questionnaires were presented to the respondents' sample in the study area. The questionnaire was directed to local communities' residents, employees of public health and employees of natural resources. While the second type of data included laboratory data: through which, three samples of wastewater were collected from

three different locations in the study area which were; Paloch, Gumry and Adar Yale.

### Data Analysis :

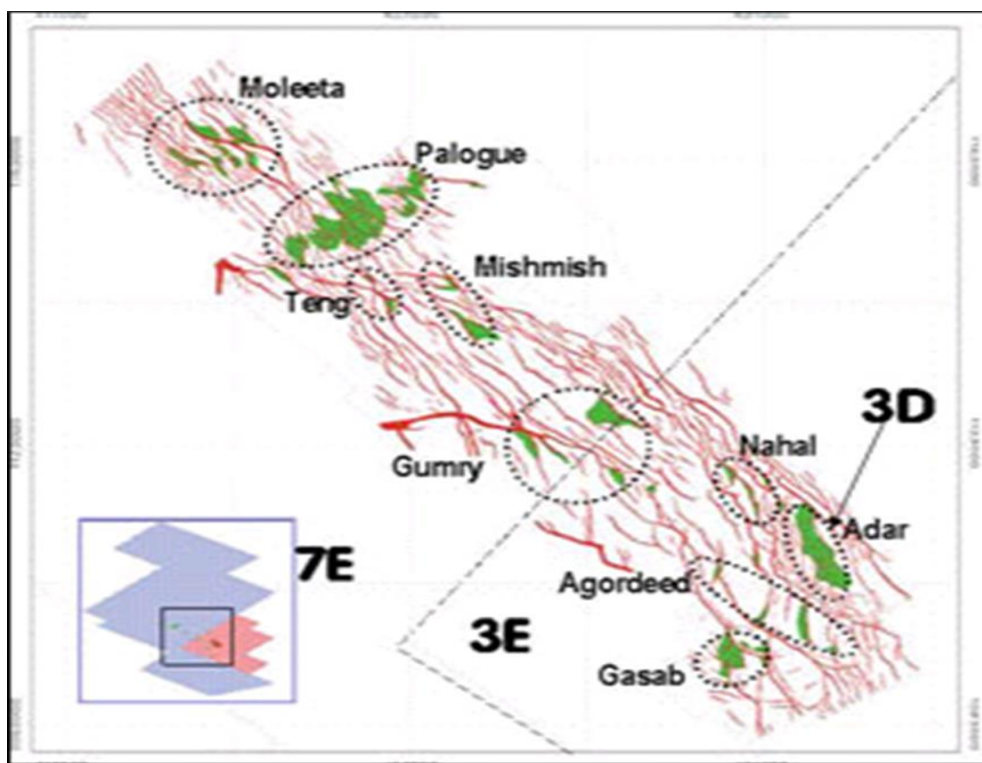
For the first set of data analysis (Primary data) Statistical Package for Social Sciences (SPSS) was used, through which descriptive statistics was used for the questionnaire in form of ratios, tables, percentage and frequency distribution to achieve the objectives of the study. While for the second set of data analysis (laboratory data) concerning the samples of wastewater a device called Atomic absorption Spectroscopy (AAS700), this device as standard method to determine the contamination by heavy metals (Hg, As, Pb, Fe and Mn) which were mixed with hydrocarbon and organic.



Map (1): The study area: (Melut is no. (3) and Maban is no. (7)



Map (2): South Sudan State:



Map (3): Wastewater samples locations (Palogue, Gumry and AdarYale)



## Results and Discussion:

This part of the study is devoted for data analysis and discussion as follows:

### 1. Analysis of the questionnaire:

#### Analysis of residents' questionnaire:

Figure (1) indicates that 94.1% of respondents noticed that rainfall water was decreased in the study area compared to only 5.9% who said that it increased. This result was not agreed with the finding of (Awosike. L F 1998) which reflects the impact of the global climate change and sea level rise on coastal resources and energy development in Nigeria.

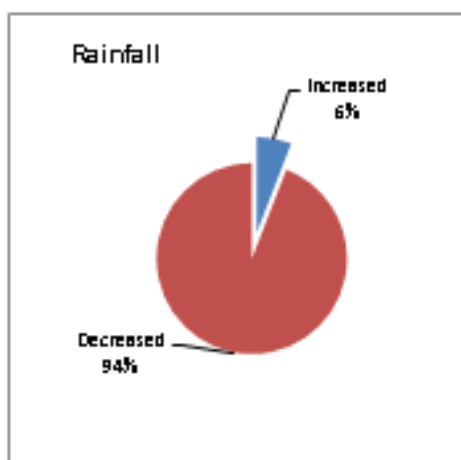


Figure (1) Distribution of the respondents by their perception of rainfall.

Figure (2) indicates that 65.9% of respondents noticed that the temperature decreased in the study area compared to 34.1% who said that it was increased. In contrast to the result of (Zeidani, M. & Maini, B. B. SAGD. 2016) who were found that; the temperature was increased in Calgary, Alberta, Canada. Normally, the decrease of weather temperature degrees leads to the reduction of rainfall and precipitations. So, the finding of this table

was strengthening with the one of the tables (1) regarding rainfall reduction.

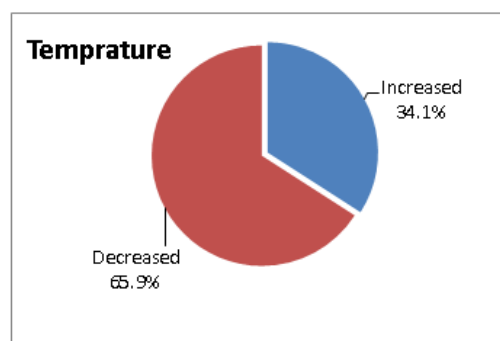


Figure (2) Distribution of the respondents by their perception of temperature:

### 2. Analysis of public health employee's questionnaire:

Figure (3) shows that 86.2% of respondents reported that distortion of newly born children increased while only 13.8 % of them who were reported that it was decreased. This result was agreed with the findings of (Ana G, Sridhar MK, Bamgboye EA. 2009) in communities of the Niger delta area, Nigeria.

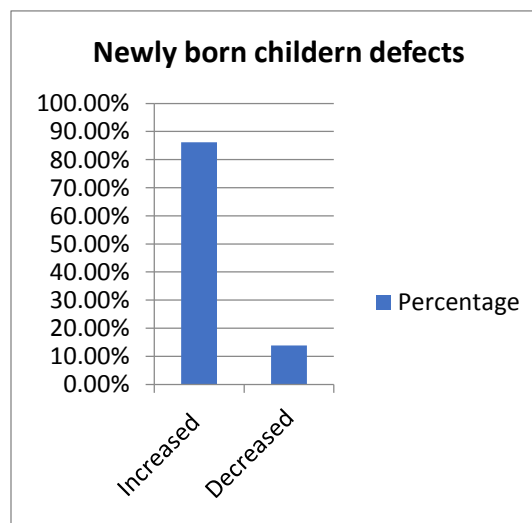


Figure (3) Respondents observations of the newly born Children defects:

Figure (4) shows that 93.8% of respondents reported that death of infants was increased while only 6.2% of them who were reported that it was decreased. This result was agreed with (Bruederle A. and Hodler R. 2019). Regarding the effect of oil spills on infant mortality in Nigeria.

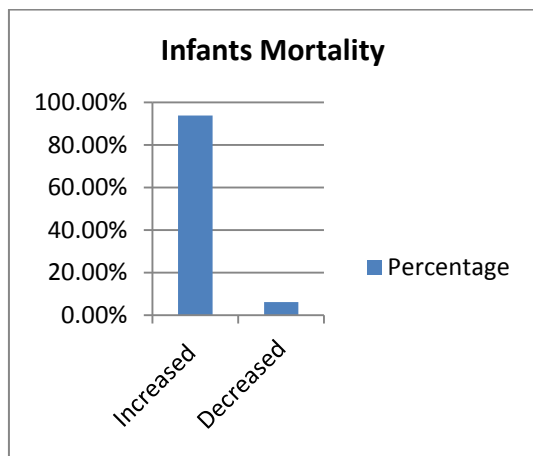


Figure (4) Respondents perception about infants' mortality

Figure (5) shows that 90.8% of the respondents reported that infertility infection was increased while only 9.2% of them who were reported that it was decreased. This result was agreed with the one of (Lindén O, Pålsson J.2013) in Ogoniland, Niger Delta Ambio.

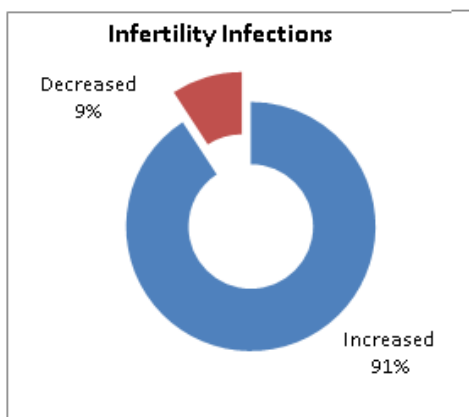


Figure (5) Respondents perception

about Infertility infection:

Figure (6) reflects that 75.4% of the respondents reported that eyes and skin allergy infection increased while 24.6% of them reported that it decreased. The result was very similar with the findings of (Apfelbacher CJ, Radulescu M, Diepgen TL, Funke U .2008)

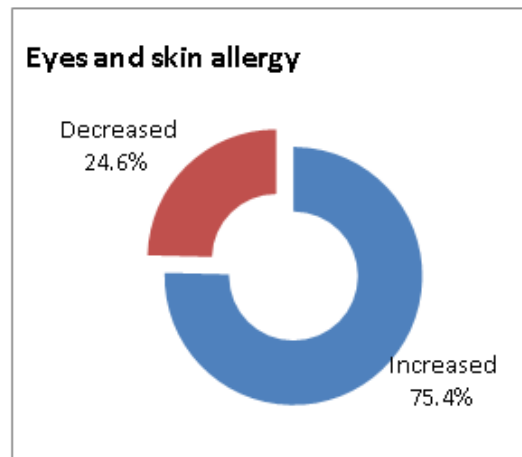


Figure (6) Respondents observation about incidences of eyes and skin allergy:

Table (1) reflects that 66.2% of the respondents reported that teeth decay and hair falling infection increased while 33.8% of them reported that it decreased. In the same trend (Lin YS, Egeghy PP, Rappaport SM.2008) were reported throat irritation, skin irritation and rashes, which were consistent with exposure to high concentrations of PAHs and VOCs found in oil.

Table (1) Respondents observation about teeth decay and hair falling cases:

| Teeth decay and hair falling | Number | Percentage |
|------------------------------|--------|------------|
| Increased                    | 43     | 66.2%      |
| Decreased                    | 22     | 33.8%      |
| Total                        | 65     | 100%       |

### 3. Analysis of national resources employees' questionnaire:

Table (2) indicates 67.7% of the respondents replied that animals were drinking in waste water compared to 32.3% who did not see it. The result was the same with that one in <http://www.ncifap.org/issues/environment> the effects of water pollution.

Table (2) Respondents observation of animals drinking the wastewater:

| Animals drinking | Number | Percentage |
|------------------|--------|------------|
| Drink            | 44     | 67.7% %    |
| Not drink        | 21     | 32.3. %    |
| Total            | 65     | 100%       |

Table (3) indicates 58.5% of the respondents replied that the rainfall water was mixed with the petroleum wastes compared to 41.5% who did not notice that. This was agreed with finding of (Auld, H., MacIver, D. and Klaassen, J. 2004).

Table (3) Respondents observation of rainfall water mixed with petroleum wastes:

| rainfall water mixed with petroleum wastes | Number | Percentage |
|--|--------|------------|
| Mixed                                      | 38     | 58.5%      |
| Not mixed                                  | 27     | 41.5%      |
| Total                                      | 65     | 100%       |

Table (4) illustrates that 83.1% of the respondents reported the death of birds around the petroleum pits compared 16, 9% of them did not noticed it. Furthermore, human and animal drinking water contaminated with petroleum hydrocarbons can cause an upset stomach,

stomach cramping, nausea, vomiting, and diarrhea, throat and mouth may also irritate, visit ([health.hawaii.gov/Navy Water](http://health.hawaii.gov/NavyWater)).

Table (4) Respondents death of birds around petroleum pits:

| Death of birds | Number | Percentage |
|----------------|--------|------------|
| Death          | 54     | 83.1% %    |
| No death       | 11     | 16.9. %    |
| Total          | 65     | 100%       |

### Analysis of wastewater samples in the study area.

Table (5) and Figure (7) indicate the analysis of wastewater of petroleum samples polluted by heavy metals mixed with hydrocarbon and organics in the study area, On the other hand, three of the five elements which were Hg, As and Pb showed a higher concentration compared to the normal international allowed figure which is 10 mg. L<sup>-1</sup> for Hg, 5 mg. L<sup>-1</sup> for As and 0.48 mg. L<sup>-1</sup> for Pb. While figures for the two elements Fe and Mn were lower than the allowed figures which were (25-30) mg. L<sup>-1</sup> and 2.3 mg. L<sup>-1</sup> successively. While the analysis of the same heavy metals was found different in country like Nigeria (34.96 mg. L<sup>-1</sup> for Hg, 1.06 mg. L<sup>-1</sup> for As, 2.39 mg. L<sup>-1</sup> for Fe, 1.11 mg. L<sup>-1</sup> for Pb and 0.85 mg. L<sup>-1</sup> for Mn) ((Duffus 2002)).



Table (5) Analysis of wastewater samples in the three locations of the research area.

| Elements<br>Location | Hg/mg. L <sup>-1</sup> | As /mg. L <sup>-1</sup> | Fe / mg. L <sup>-1</sup> | Pb/mg. L <sup>-1</sup> | Mn/ mg. L <sup>-1</sup> |
|----------------------|------------------------|-------------------------|--------------------------|------------------------|-------------------------|
| Paloch               | 20.500                 | 19.020                  | 18.796                   | 0.954                  | 1.170                   |
| Adar Yale            | 18.709                 | 16.462                  | 11.931                   | 0.968                  | 0.633                   |
| Gumry                | 15.709                 | 15.350                  | 10.487                   | 0.832                  | 0.765                   |

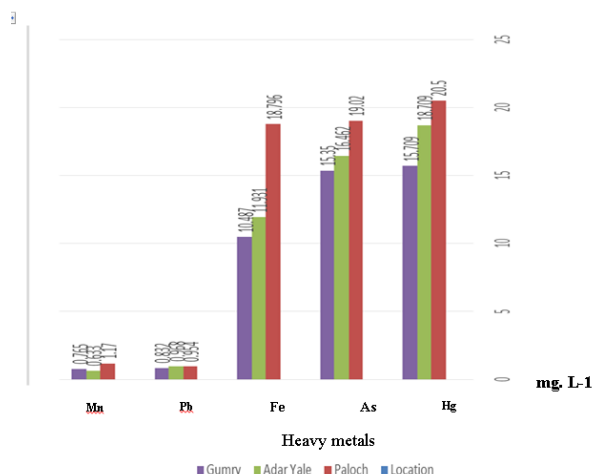


Figure (7) Analysis of wastewater samples in the three locations of the study area.

### Conclusion and recommendations:

Until recently environmental issue has been largely ignored and neglected in Paloch and Adar Yale South Sudan. The case of petroleum impact on the study area needs more efforts from authorities and communities to observe that problems and initiate development projects with reference to profit maximization and positive impact. The environmental has capacity to provide for human needs with resources conservation is important to develop the areas of oil productions and reduce the negative impact whether economic growth, environmental protection is important to save the life of human health, animals, organisms and ecosystems in oil production areas. Paloch and Adar Yale must get much development in many aspects of life such as education, health, clean water, energy and compensation to citizen who lost their lands

because of oil production activities. On the other hand, many problems arise with time to cause hazards to human livelihood. Petroleum activities in the study area caused problems on water and local environment Such as rainfall temperature decreased, public health employee's distortion of newly born children's, death of infants, infertility infections increased. Animals normally drink waste water, rainfall water mixed with petroleum waste, the death of birds around the petroleum pits. The study indicated that there is a wastewater contaminated the area. Finally, the study recommends that avoid using water near the petroleum wells because it contains heavy elements that affect human and animals health, treat the wastewater for human and animals use, Petroleum companies have to commit to the rules and laws that related to the petroleum work and they have to contribute positively in the area development and local community awareness and authorities have to make a preventive barricade to a void mixing of rain water with petroleum waste.

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## تأثير المخلفات البترولية في المياه والبيئة المحلية لمنطقتي ملوط ومابان بولاية أعالي النيل – جنوب السودان

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• تاريخ استلام البحث 08/01/2023 وتاريخ قبوله 16/03/2023

• البحث مستل من اطروحة دكتوراه للباحث الاول .

### المستخلص

هدفت هذه الدراسة لمعرفة تأثير المخلفات البترولية في المياه والبيئة المحلية في منطقتي ملوط ومابان بدولة جنوب السودان. احتوت شاملة الدراسة على 30000 من ساكني المنطقة البحثية. تم اختيار 265 مبحوث عشوائيا ليمثلوا عينة الدراسة. واشتملت المتغيرات البحثية على ثلاثة، أولاً: المياه الملوثة بالمخلفات البترولية، ثانياً: الحالات الصحية للمواطنين وثالثاً: الأثر على البيئة المحلية. تم جمع نوعين من البيانات بطريقة المسح العام، وهما (البيانات الأولية) وجمعت باستخدام الاستبيان مع السكان المحليين وموظفي الصحة والموارد الطبيعية بالمنطقة البحثية و (البيانات المختبرية) والتي جمعت من خلال اخذ عينات من مياه ثلاث حفر من المخلفات البترولية المائية في ثلاثة مواقع بالمنطقة البحثية. تم تحليل البيانات الأولية باستخدام برنامج SPSS من خلال التحليل الوصفي. أما تحليل البيانات المختبرية فقد تم باستخدام جهاز منظار الامتصاص الذري (AAS 700) لمعرفة مستويات عناصر (الحديد والرصاص والأر سينيك والزنك والمنجنيز) في عينات المياه الملوثة. أظهرت نتائج الاستبيان أن 94,1% من مبحوثين السكان المحليين لاحظوا قلة الامطار في المنطقة، وأن 65,9% منهم لاحظوا نقصان درجات الحرارة، وأن 86,2% من مبحوثين موظفي الصحة سجلوا حالات ولادة اطفال مشوهين وأن 74,4% منهم سجلوا وجود امراض حساسية العيون والجلد وأن 66,2% سجلوا حالات تساقط الاسنان والشعر وأن 90,8% منهم سجلوا حالات عقم وسط النساء، وان 93,8% منهم سجلوا حالات موت لأطفال حديثي الولادة. وأن 83,1% من مبحوثي الموارد الطبيعية سجلوا موت للطيور حول المخلفات البترولية المائية، وأن 67,7% منهم لاحظوا شرب الحيوانات من المخلفات البترولية المائية وكما أظهرت نتائج التحليل للبيانات المختبرية وجود عناصر مثل الزئبق والأر سينيك والرصاص بمستويات أعلى من المستوى المسموح به دولياً في المياه، بينما كان عنصري الحديد والمنجنيز أقل. وقد أوصت الدراسة بعدم استخدام

المياه قرب آبار البترول لاحتوائها على عناصر كيميائية ثقيلة ومعالجة المياه لاستخدام الانسان والحيوان وأن على شركات البترول الالتزام باللوائح والقوانين المتعلقة بأعمال استخراج البترول والمساهمة في تنمية وتوعية انسان المنطقة.

**الكلمات المفتاحية :** المخلفات البترولية، المياه، البيئة المحلية، أعالي النيل، جنوب السودان.