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Special Report

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Sitting on a Time Bomb: Oil Pollution Impacts on Human Health in Melut County, South Sudan

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"The produced water that is in Mujama is a time bomb. What if it rains, and the whole area floods? All the water will burst and flow into the river and it will kill everyone here in Melut and Adar." Traditional Leader in Melut.

Summary

While South Sudan is endowed with 3.5 billion barrels of proven oil reserves, the exploitation of this natural wealth is turning into a catastrophe for some local communities, particularly in Melut County. Through focus group discussions, individual interviews, and field observations, we found the following:

1. Many households in Paloch, Melut County, are in close proximity to oil wells and facilities, and within a short distance of a large lake of toxic produced water, exposing them to highly toxic chemicals.
2. Livestock graze around the oilfields, passing on highly toxic pollutants to residents through the food chain.
3. Community drinking water, held in containers that are placed on dusty roadsides by Dar Petroleum Operating Company (DPOC), and chemical containers used by community members to hold water, are likely sources of human exposure to toxic contaminants.
4. Communities have repeatedly complained about a high prevalence of petroleum pollution that causes diseases and reproductive health issues, including birth defects, infertility, stillbirth, and miscarriages, among others. We discovered 13 cases of

birth defects, including spinal bifida, facial and head deformities, sexual organ deformities, limb deformities, and growth retardations.

5. All of the participants expressed anger and frustration, a sign of a more serious potential crisis that could cripple petroleum industry operations in the area, if not prioritized and addressed.

We recommend the following to the Revitalized Transitional Government of National Unity (RTGONU) and DPOC:

1. Urgently identify areas sufficiently distanced from the oil fields, build basic services infrastructure in those areas, and relocate residents away from the oil fields and facilities;
2. Fence off the oilfields to prevent access by humans, livestock, and wildlife;
3. Conduct a comprehensive environmental and social assessment similar to the one that has been conducted in Ogoniland in Nigeria by the United Nations Environment Programme (UNEP) to assess the extent of pollution damage, determine compensation and remediation costs, and make recommendations that are enforceable through an act of parliament or a presidential order; and
4. Expedite the tabling, review, and passage of the draft Environmental Protection and Management Bill to strengthen environmental protection rules and enforcement capacity to better protect the health and welfare of those South Sudanese suffering from oil industry operations.

1. Introduction

South Sudan is endowed with about 3.5 billion barrels of proven oil reserves, the third largest in Africa.[1] Yet this wealth is proving to be a curse to local residents in the oil producing areas due to lax environmental protection rules (Bol, 2014, ECOS, 2010, Tiitmamer, 2015, 2016). The process of oil exploration, development, and production is known for its generation of hazardous waste that has adverse impacts on humans and the environment (Pathak and Mandalia, 2012). Basically, the oil and gas industry has been an inherently hazardous undertaking since the first oil wells were drilled in the United States in the 1800s (Otton, 2006). Oil industry processes affect the environment through exposure

[1] See a report by Africa Oil and Power, https://www.africaoilandpower.com/2020/09/09/south-sudan-with-an-eye-on-oil/

to produced water, oil leakages, oil spills, gas flaring, and drilling cuts, among other damaging actions (Kumar et al., 2013, UNCTAD, 2007). Oil pollutants severely affect human health because they contain heavy metals, salts, naturally occurring radioactive materials, and hydrocarbons which cause diseases such as cancers and reproductive problems such as birth defects, infertility, and miscarriages, among others.

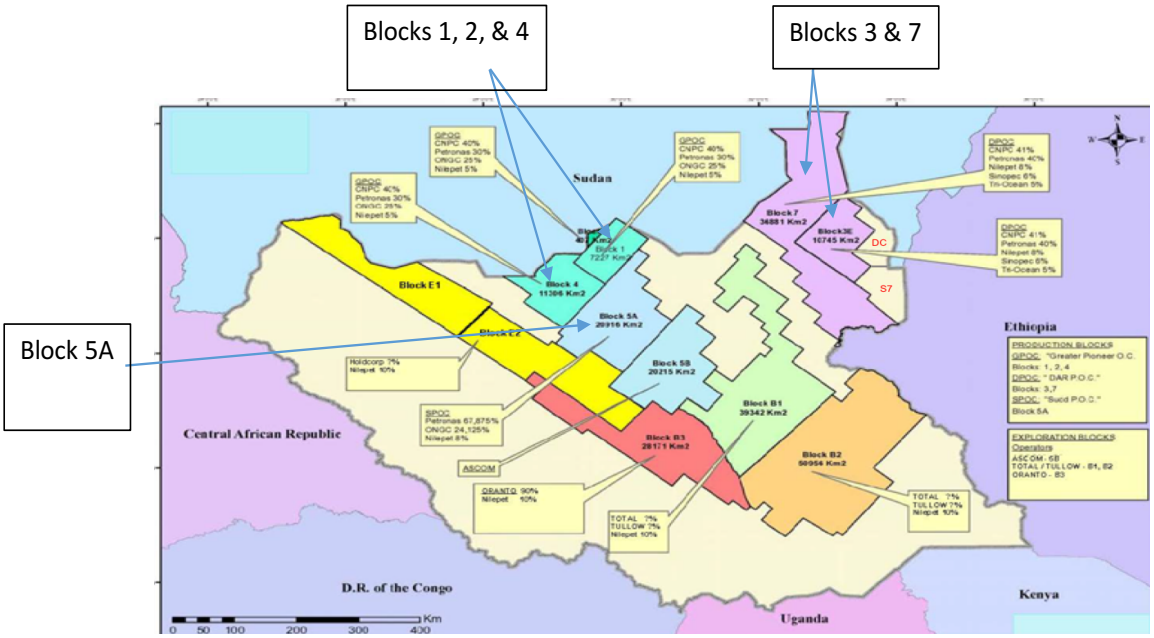
Studies on water in the oil producing areas in South Sudan show high concentrations of salt and heavy metals resulting from oil exploration, development, and production (Patey, 2012, Bol, 2014, ECOS, 2010, Rueskamp et al., 2014, Moro, 2009). Unregulated exploration and production of oil, poor maintenance of oil pipelines, and faulty equipment which allow the oil to spill, coupled with lack of monitoring and enforcement, have turned oil producing areas in South Sudan into some of the world's most petroleum-polluted ecosystems (Tiitmamer et al., 2020, Patey, 2012, Bol, 2014, ECOS, 2010, Rueskamp et al., 2014, Moro, 2009).

While many studies have shown high levels of negative environmental impacts, little is known about the link between petroleum pollution and the extent of such impacts, particularly on human health in South Sudan. Oil companies have often denied the direct link between health incidents discussed in this report to oil production and resultant pollution. This study[2], therefore, attempts to understand the extent to which local people have been exposed to oil pollution and establishes the prevalence of cancer diseases, birth defects, infertility, miscarriages, and other health issues in Melut County, Upper Nile State.

The study focusses on blocks 3 & 7 as shown in the South Sudan's oil concession map (see Figure 1). Blocks 3 and 7 are operated by Dar Petroleum Operating Company (DPOC), a consortium that explores, develops and produces oil on behalf of China National Petroleum Corporation (CNPC), Malaysia's Petronas, China's Sinopec International Petroleum Exploration and Production (SIPC), Egypt's Tri Ocean Exploration and Production (TOEP), and South Sudan's Nile Petroleum Corporation, also known as Nilepet (EIA, 2018). In addition to DPOC, there are a number of oil services companies contracted by DPOC to carry out several works in blocks 3 and 7. The rest of this Report proceeds as follows. Part 2 presents methodology; Part 3 provides the findings and discusses them; and Part 4 concludes the Report with recommendations to address harmful impacts on the local population and the environment.

[2] This research production has been made possible through financial support provided by CORDAID. However, the views expressed in this paper are not CORDAID's views

Figure 1: South Sudan's Oil Concessions Map



Source: Ministry of Petroleum with additional illustrations by the authors.

2. Methodology

Guiding questions were formulated for the focus group discussions and one-on-one interviews. We used a questionnaire for this study because it is the most suitable research instrument for a descriptive assessment (Kombo and Tromp, 2005). Secondary data, in published literature about how oil exploration and production degrade the environment, resulting in occurrence of diseases, were also utilized. In Paloch, we held focus group discussions with a total of 32 community participants. Of these, 5 participants were women, 3 participants were youth, and the rest were male elders. In Melut Town, 27 community participants attended focus group discussions and they included 11 elders, 9 women, and 7 youth. We conducted a total of 11 individual interviews to complement the focus group discussions.

The original research plan was to use a household survey to determine the prevalence of petroleum pollution related diseases. However, due to restrictions by the authorities, the study team conducted focus group discussions and individual interviews among the communities. Government security officers that protect the oilfields were supposed to be informed by the Ministry of Petroleum of this study. However, no notice was sent to them

and therefore, when the research team arrived in the field, the security officers did not grant permission. Even though the team showed a permission letter signed by the Minister of Petroleum, they insisted that they should be informed first directly by the Ministry before the survey should proceed.

As a result, the research team opted for focus group meetings and interviews with local government representatives, traditional leaders, women and youth representatives, and members of community instead of a house-to-house community health survey. The focus group discussions and one-on-one interviews were conducted in Melut and Paloch Towns between March 26 and April 2, 2019. Participants did not only come from the two locations, but they also came from Adar and other places within greater Melut.

The study aimed at determining (1) the exposure pathways to petroleum pollution, (2) residents' perceptions about the quality of the environment now and in the past, (3) prevalence of petroleum pollution diseases and any strange health phenomena, and (4) prevalence of reproductive health issues such as infertility, miscarriages, premature births, stillbirths, and birth defects, among others.

To understand the exposure pathways of residents to petroleum pollution, we asked respondents about their sources of water, food, locations of farms, and pastures, and locations of residents in relation to the oil wells and other oil facilities. We also asked if they are satisfied with the environmental quality of the air, land, and water and whether they believe the water they drink and the food they eat are clean and safe. In addition, we asked participants about their perceptions of the past environmental quality in their areas. Lastly, we asked participants to name any known disease or describe any strange phenomena that may have affected them or any of their family members.

3. Findings and Discussions

3.1. Pathways to pollution exposure

We asked whether the residents of greater Melut area are exposed to pollution in any way. All the study participants affirmatively responded. They agreed in their statements that the environment and its components of air, water and soil in the area are contaminated and poisoned by the oil production. They also agreed that pollution has been happening because DPOC and the government in Juba have not done enough to stop it. They also complained that researchers, journalists, community politicians, and civil society organizations always come to take information but no action is taken. For example, one of the traditional leaders in Paloch told the team:

> "What has been done here is under the responsibility of the government. What is causing diseases is the fact that the companies are not following environmental

> standards yet the government does not penalize the companies. If the government intervened, this would not be happening. We are here because of the trees. We need medicines. We used to ask why are you digging the land like this, would it not kill us? The government should have been guiding us. Water smell bad. Air is smelling bad. The companies do not clean up. If they clean up, there would be no problem. The government is the one who should intervene. You are coming to take the information from us, but you will not come back with solution."

A traditional leader from Melut Town also expressed the same concerns:

> "It is good if someone comes to you and there is a feedback. There are many people who have come here but there has been no feedback. Is it the government that does not take action or is it you who come who does not tell the government our sufferings? We are getting contamination from water, milk and food because of the petroleum pollution. Before the oil, there were no diseases. Oil has brought diseases."

They pointed out that people, whether from Melut, Paloch or Adar Yale, drink water supplied from the Water Treatment Plant situated in Melut Town but added that this water is distributed to the communities or villages in barrels and containers which are placed near the main roads, leading to its exposure to petroleum contaminated dust.

On the question of how the communities have been exposed to pollution, a traditional leader from Paloch told the team:

> "We are staying here surrounded by oil wells. We cultivate around these oil wells. It is the crops we grow here that we eat. We have cows, goats and they have no place to graze. They graze around oil wells. They drink water near oil wells. Cows are not like people. We try to let them drink clean water but sometimes they drink polluted water. It is these cows that are slaughtered here to be eaten by people at homes and in restaurants."

A representative from Adar expressed views with regards to the exposure pathways:

> "People living near oilfield wells are mostly affected. It is these people who are giving birth to such defected children. That said, I also believe that the white Jerkins which are used as chemical containers, but later used by the local communities as water containers, are the culprits of the many diseases that are now befalling the communities. Further, the black tents which are brought to be used as waterproof in evaporating ponds are now being used by the local communities for building their houses. These tents also cause diseases to the community members."

The participants clearly described their sufferings, which they connected with petroleum pollution and they repeatedly complained that the government has neglected them. For

example, one of the traditional leaders we interviewed did not mince his words in describing the situation:

> "I thank you for coming all the way from Juba to ask us how we are. You have heard from our local government representative. There is no day that has no meeting and workshops but nothing happens. We are suffering. Women are not giving birth. People are getting blind. When you are thirsty and drink, you get a disease. What has helped us is that the rain has not come in the last several years. Many people would have died. South Sudanese hate us, yet our land gives them oil! Birds used to be here, but they are no longer here. If you have come to ask us, we can tell the truth. We can tell you the truth. We are dying and it is the petroleum that is killing us. We are good people because we did not surrender our land to the Arabs. Why should we be allowed to suffer from diseases, yet we fought for this land to be the land of South Sudan? We need medicines. We need hospitals. We need schools. We were told that we would benefit from this oil but the people far away from this area are the ones benefiting! The government does not bring for us food; we eat from what we grow from this polluted land. Last year when it rained, the whole area flooded; Kids who bathed or swam in these waters died! All birds, like crested crane, have migrated. Why? Because of the oil activities that come with environmental pollution. Some types of fishes in the river have disappeared! If you go to the river now, you will fish in vain.... even us will die soon. But why are they letting us die? Can't the government bring medicine to inject us?"

An elder from Melut Town also shared the same views:

> "The government is not protecting people. There is no place for cow to graze, no place for goat to drink, no place for people to cultivate. Water goes through the pipeline but we do not know what is in the pipe. Diseases are very common. It seems to the government and oil companies that money is better than human, but human is better than money. Women are not giving birth. People are getting blind."

One of the chiefs also told the team that what sustains them in the midst of this suffering is hope that someday someone will take action to rescue them. He told the team:

> "The first thing for life is water. Water is the first thing before food. Water sustains you until you find food. We are living here by patience. We are living here because it is our land. The land has been destroyed by the petroleum extraction, but we do not have an alternative land to go to. NGOS come and go. They encourage us to be patient. Many people have talked, and everything has been said. We are patient because we hope a solution will come. We cannot leave because this is our land. Nobody will give us the land or vacate his or her land for us if we move to his land.

> We are dying here because it is our ancestral land...we have nowhere to run to. We are hoping in vain. NGOs have come but no action has taken place. We are hopeful and it is hope that keeps us going, that things will be okay one day."

The participants narrated that the toxic chemicals from the oil industry also poison the soil used for cultivation. They noted that people in Melut and Paloch eat sorghum that is cultivated on this contaminated soil. Some people drink from ponds, which are contaminated with produced water. Cattle graze on grasses from the same soil and people eat their meat and drink their milk, which might have been contaminated too as stated below by a Paloch local government representative:

> "Water is brought by water tanks and placed on the roadsides. They are not taken to people's houses. People have to come and collect it. The water that is provided is not clean because sometimes dust that have chemicals may get in. There are no places to cultivate just like the chief said. It is the places of oilfields that they also cultivate. Livestock also graze and drink from oilfields. There are no special ponds dug for livestock to drink. They drink water in the environment in the oilfields. The soil has changed. Before petroleum [exploration and production], a small piece of land would have high yields. The air is not good. You might have passed near the big pond over there. There is no bird that can pass over that pond. When a bird passes., it dies. These ponds evaporate and have chemicals. Trees are also suffering."

All these statements were further echoed by others in the focus group discussions. In summary, the participants repeatedly told the team that soil, water and air are all contaminated with oil-related chemicals. They reiterated that they are losing patience and hope as neither DPOC nor the government are doing anything tangible to stop the catastrophe.

3.2. Perceptions on quality of the environment

On the quality of the environment, all the participants told the team that the quality of environment has been severely affected. The participants attributed the environmental degradation to an array of malpractices that include improper disposal of oil drilling muds, cuttings and produced water. The biggest concern for the communities is the produced water: the water separated from oil that is supposed to be disposed of properly. One of the traditional leaders in Melut described the problem of produced water in a very alarming way:

> "The produced water that is in Mujama is a time bomb. What if it rains, and the whole area floods, all the water will burst and flow into the river and it will kill everyone here in Melut and Adar. The contaminated water will go to toich [swamps] and rivers."

A women's representative from Adar expressed similar concerns to the team:

> "Our air, water, and soil here in Melut are not good. Before the oil production, environment was good. Now our people get sick when they drink water, when they eat, and when they smell air. Oil has ruined our environment and is killing us. Paloch is worse than Melut. "

In addition to unanimous agreement from the members of greater Melut that the environment is degraded, the team also observed many environmental malpractices on the grounds. We saw an array of oil wells, oil processing facilities, and a large lake of produced water sitting right along Paloch –Melut Road. Additionally, we also observed livestock grazing and roaming around and within the oil fields. Villages, farmlands, and supplies of drinking water were seen situated around or on the sides of road within the oil fields in greater Melut areas.

All the concerns and perceptions of the communities in the oil-producing areas about the bad quality of their environment as narrated above are further reinforced by the existing literature. As mentioned previously, "oil exploration and production have all along been observed to have numerous negative effects on health, safety and environments" (Moseley, 1983). For example, "heavy metals, hydrocarbons, salts and naturally-occurring radioactive materials in the oil exploration mud and produced water always find their ways into the physical and biological components of the area ecosystem" (Moseley, 1983). Due to the process where the ecosystem recycles nutrients within the food chains, "many toxic pollutants from oil exploration and production can also enter and circulate within the ecosystems in the same ways as nutrients" (Moseley, 1983). As a result, "heavy metal accumulation can affect the growth of flora and fauna at the discharge ecosystem, leading in turn to a bioconcentration of heavy metals or hydrocarbons in several organisms such as plants, invertebrates and birds, when the environment experiences a chronic exposure of petroleum or its derivatives" (Bayode et al, 2011). Thus, "producers such as plants in the area pick up these chemicals and pass them into primary, secondary and tertiary consumers, including humans within the food chains and food webs, leading to health issues" (Ismail, et al, 2017). This exactly parallels the situation of Melut oil-producing Area.

3.3. Diseases and reproductive health issues

When asked about the prevalence of petroleum pollution-related diseases among members of their communities, all the discussants asserted that different kinds of diseases such as cancer and other mysterious inflammations, leukemia, kidney failure, eye irritation, and skin rashes are occurring in high rates in their areas, citing names of their loved ones who have suffered or are suffering from such ailments, plus many other cases of reproductive health.

A local youth organization representative in Paloch, vividly described:

> "Many diseases are occurring in our area: blindness, reproductive health complications, and sudden deaths are currently taking place in the area due to pollution from oil production. Deaths have become common and women are not giving birth as they used to do in the past. Miscarriages are very common. All this has been conveyed to the government, but so far, no answer. We need doctors to come to the area in order to confirm the cases we have been suffering from."

A traditional leader from Melut also expressed the same sentiments:

> "Diseases that are happening here have never happened before. There are diseases of people, diseases of cattle, and diseases of crops. These have been caused by petroleum. People used to get old to the extent that they could be carried by people. I used to carry old people who were too old to walk but they were old yet they were still able to see. Oil companies discriminate – DPOC workers are vaccinated but people of Sudd company are not vaccinated. We do not need talk anymore, we need action, we need doctors to test us and to provide medicines. It is the water from the petroleum that is killing people."

A chief from Paloch Payam also raised the same issues:

> "When you go to the hospitals, especially maternity ward, you can see what is really happening to us and our wives. There are babies born with defects or prematurely. Women have a lot of miscarriages. Some diseases come to us suddenly and take lives away. In the past as I remember, deaths used not to occur to people suddenly like that. All these are now happening because of oil production. Cases of infertilities are also bothering us in Melut Town. What is happening to people is our great concern. Oil companies come from Juba through the government and it is the government to fix every problem that comes with these companies. That is all I have to tell you. Our kids, our animals, our wives and we are now in dire situation. Most of us in this room are now carrying medicines or wearing glasses because of the diseases I have just told you. The environment is not good at all. Oil and its produced water are killing us, our kids die when they take bath in open ponds. It is your responsibility to save us from all these ordeals."

A representative of Bimachok area of Melut County echoed the same sentiments and added:

> "There are many cases of infertility among both women and men in the area. Cancers are rampant in our area. Kidney failures and leukemia have happened to some people here [and he mentioned the names]. Hepatitis cases are rampant, and no doctors are sent to treat us. We are crying for help and God will hear us one

> day. We are demanding health services from diagnosis to treatment. We are demanding the oil companies to vaccinate all the citizens, not only their employees."

When a County Official was asked on the prevailing diseases and reproductive health issues in Melut county, he said cases of babies being born deformed are lower in Melut Town, but very common in the territories of Paloch Payam. He added that although these cases have been reported to the authorities in the last decade, he does not know why they have not been resolved. He also stated high prevalence of other cases such as eye and cancer diseases and infertility, all of which he directly linked to oil pollution. Besides, he said other diseases such as HIV/AIDs are prevalent in Melut and he suspected the petroleum workers to have brought it to Paloch. As to his recommended solution, he advocated relocating the people of Paloch to safer areas. In particular, he recommended the relocation of the local communities of Ageer Dinka to the area of Mabek and Gutmoch along the Nile River and the Nyiel Dinka of Adar Yale to Phanomdit and Phanomthei Payams, where there is little oil exploration or production.

A Payam Official in Paloch also raised the same concerns:

> "All types of diseases are occurring in Paloch Payam and these include defected babies, infertility among women and men, and miscarriages. Livestock and water also give us diseases. Eye diseases, skin diseases, and sudden deaths caused by cancers are rampant as a result of oil production."

A women's representative from Paloch echoed the same observations:

> "Paloch has many problems; women are having a lot of miscarriages; they face many challenges during pregnancies and undergo many operations. Men also suffer from diseases. The diseases do not stop; today is a baby who is sick, tomorrow our husbands and the next day is us, we do not have money to take our people to the hospitals here or in Juba or Khartoum."

A 43-year-old interviewee from Adar also shared similar views with the team:

> "Since 2007, an increasing number of babies have been born also here in Paloch without arms. Twins were born connected by one head some two years ago. Another baby was born in 2018 as a log without any features of a human being."

Our team identified 13 cases of birth defects and one case of stillbirth. Most of the birth defect cases include spinal bifida, facial and head deformities, sexual organ deformities, limb deformities, and growth retardation issues, among others. Table 1 provides a summary of these cases. Personal details have been removed to protect privacy. We made a number of observations. First, the community is concerned by birth defects and other reproductive health issues. They are concerned that the future of the community is in

jeopardy as its continuity lies in procreation. It was hard for the members to admit in public whether one has a relative who experienced birth defects because of cultural stigma. Most of the birth defect cases are not publicly reported because of this stigma, leading to an underestimation of the magnitude of the crisis. Most of the babies unfortunately are not alive because of traditional beliefs. They are taken to the river following a ritual of a he-goat killing. This also removes evidence, leading to underestimation of the magnitude of the crisis, subsequently delaying remedial actions from being taken.

Table 1: Cases of birth defects in Melut County, Upper Nile State

Case	description	Place	year
1. Case 1	3 kids with deformities that including a face deformity	Paloch	year not mentioned
2. Case 2	Problem with male organs.	Thiangrial	1998
3. Case 3	A baby born with small body but very big head – they say there is water in its body.	Wunthon near Moleeta	2017
4. Case 4	A baby born with water in its head	Melut Town	2013
5. Case 5	A stillbirth	Melut Town	2013
6. Case 6	A baby born with normal head but the head grew big over time. People say there is water in its head before it passed away.	Paloch	2013
7. Case 7	A baby born with problem in its head and back and could not sit or stand (they described it as eagle resembling).	Melut	2018

8. Case 8	A baby born normal but did not grow and was always suffering from common cold	Paloch	2015
9. Case 9	a baby girl born with big eyes but could not see or hear and was taken to the river, according to traditional beliefs and practices	Paloch	2011
10. Case 10	A baby born with something intruding out like a tail at the back before it died	Paloch	Year not mentioned
11. Case 11	A baby born with a large head. It passed away after surviving for 7 years	Paloch	Year not mentioned
12. Case 12	A baby born with eagle characteristics (it could not sit or stand)– it was thrown into the river after a goat killing ritual according to traditional beliefs.	Paloch	Year not mentioned

3.4. Discussions and policy implications

As this study reveals, people are highly exposed to a toxic petroleum environment through residing in close proximity to oil facilities, food chain, old chemical containers, and plastic sheets taken by communities for domestic purposes, leading to cancer diseases and reproductive health problems. In addition, all the focus groups in both Melut and Paloch Payams cited the causes of their sufferings as DPOC's non-compliance with national laws as well as international best practices and government's failure to take action.

These findings reaffirm empirical evidence in the literature. In similar contexts, proximity to oil facilities is associated with high risk of cancer (William et al., 2020). For example, in a study in Texas, United States, those living within 0 to 10 miles from the oil refineries were found to have the greatest risks of cancer. This is because direct release of petroleum pollutants affects humans residing near oil facilities through smelling of polluted air, drinking of contaminated water, bathing using contaminated water or eating whatever they grow in contaminated soil (Robert, 1993). A study published in the Journal Cancer also revealed residents living near benzene emitting sites had a high rate of a form of cancer called on-Hodgkin lymphoma (Bulka et al., 2013). Another study published in Journal Environmental Pollution also links high rates of cancer to living near chemical facilities (Ayuso-Álvarez et al., 2020).

Proximity also determines the severity of impacts. As proven in similar petroleum contaminated environments in other countries, more than 10 ug/dL of lead (Pb) in the blood during pregnancy can cause fetal growth retardation, low IQ and low attention, stillbirth, miscarriage, and neonatal death, among other maladies (Bellinger, 2005, Pergament et al., 1995). High lead (Pb) can also cause hypertension and reduce neuro behavioral development (Bellinger, 2005). Men with Pb levels of between 25 ug/dL and 40 ug/dL in their blood have high risk of infertility and other associated reproductive issues (Bellinger, 2005).

These findings have critical policy implications. First, they invoke the need for the government to relocate the residents away from the oil fields. Doing so requires the government to provide basic services in the new area. This is necessary for a number of reasons. First, resettling the residents away from the oil wells and associated facilities protects the residents from petroleum pollution exposure. Second, by resettling them and providing them with basic services, the government offsets the negative consequences of pollution and the inconvenience of having to relocate the residents to the new area. Funding for such a relocation project should come from the Petroleum Ministry's community development funds stipulated in the Petroleum Act 2012, as well as from DPOC's corporate social responsibility funds. By doing this, DPOC will be obtaining a social license to operate among the host communities based on best practices.

Lastly, the findings invoke the need to do away with the current DPOC's approach of managing the environment, as maintaining such approach is dangerous to both the people and petroleum industry. The communities are highly dissatisfied and frustrated. The government and DPOC should not allow them to reach a point where they feel they have nothing to lose anymore because this is a dangerous point to reach. Therefore, taking action now to correct environmental degradation is good for the government and DPOC as it can restore the environment to its original conditions, protect communities and can as well provide social license to DPOC to continue to operate and extract oil to provide revenues for the government to maintain law and order and grow the economy.

4. Conclusion and Recommendations

4.1. Conclusion

This study has assessed the impact of oil exploration and production on human health in Melut County, Upper Nile State. Using focus group discussions, observations, and interviews with key participants, the results have revealed that the environmental quality of the study area is not satisfactory to the local people as the environmental components of air, water, and land ecosystem have been contaminated and poisoned by both drilling wastes and produced water. Local people cultivate, graze their herds, and get water from the same area. They also drink milk and eat meat of the livestock that graze in the polluted environment. Furthermore, they have complained of high rates of cancer diseases and reproductive health issues, which parallel empirical evidence from scholarly literature of similar contexts.

We found 13 cases of birth defects and reproductive health complications. Unfortunately, as the household survey could not be carried out fully due to restrictions from authorities, there is a need for additional studies, either on specific diseases or cohort studies of diseases in these oil polluted areas. Furthermore, this study underscores the need to carry out more studies in order to develop exposure estimates, whether in the form of air modeling, emissions data or personal monitoring data, to further ascertain the health concerns revealed through the focus group discussions and interviews with key participants.

4.2. Recommendations

To address the issues raised in this study, we recommend the following:

1. Relocate the residents away from the oilfields: as a matter of urgency, we recommend to the RTGONU and DPOC to quickly identify areas within a considerable distance from the oil fields and relocate the residents who currently live within the vicinity of oilfields. RTGONU and DPOC should build villages with full services to which the residents can be relocated. Such services should include schools, electricity, clean and safe water, sewage system, health centers, agriculture extension services and microfinance services, among others. Such provision of services should be financed using community development funds stipulated in the Petroleum Act 2012 as well as through DPOC's corporate social responsibility funds. As part of the relocation program, RTGONU should carry out a quick health assessment to identify health and reproductive health issues and make quick intervention to save the lives of those affected.

2. Fence off oilfields to prevent any access by humans, livestock and wildlife: This will protect people from further exposure to the pollution. The produced water pond should be properly fenced off from both humans and animals. Scarecrows should be installed in the space above the ponds, close to the water surface to keep away birds from landing and drinking from the pond.

3. Give absolute mandate to the ministries responsible for environmental protection, safety, and health to regulate the oil industry: The Ministry of Environment and Forestry should be empowered, capacitated and given the full responsibility to regulate and enforce environmental standards in the oil and gas industry. This includes establishment of Environmental Management Authority to assess, monitor, evaluate, and enforce environmental standards as stipulated in the Revitalized Agreement on the Resolution of Conflict in the Republic of South Sudan.

4. Conduct a credible, transparent, and inclusive environmental and social audit of all the oil operations by DPOC in particular and by other oil operating companies in general: a comprehensive environmental and social assessment similar to the ones conducted by the UNEP in the Ogoniland in Nigeria should be carried out by a reputable firm or by the UNEP itself. Such an assessment should focus on determining the extent of pollution damage, the cost of compensation and remediation, and recommending remediation of the environment and compensation of those affected. Its recommendations should be enforced through a Presidential Order or an Act of Parliament. This will begin the process of putting the environment back to its original state.

5. Lastly, expedite the tabling, review, and passage of the draft Environmental Protection and Management Bill. The Bill should put in place stringent measures and mechanisms to protect the environment.

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The Sudd Institute is an independent research organization that conducts and facilitates policy relevant research and training to inform public policy and practice, to create opportunities for discussion and debate, and to improve analytical capacity in South Sudan. The Sudd Institute's intention is to significantly improve the quality, impact, and accountability of local, national, and international policy- and decision-making in South Sudan in order to promote a more peaceful, just and prosperous society.

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