5-2022

Transmission Risk of Malaria via Gas Flares in Africa

Elle Blake
University of Arkansas, Fayetteville

Transmission Risk of Malaria via Gas Flares in Africa:

How gas flaring affects human health and the environment

Elle Blake

Spring 2022

University of Arkansas

Abstract

Gas flaring occurs at oil drilling sites around the world. It is a method to get rid of the extra gas, as well as to release pressure in emergency situations. The pollutants that are contributed to the air through routine gas flaring can be extremely harmful. Chemicals such as sulfur dioxide and methane are burned into the air we breathe (Baker Hughes, 2019). Not only does this have a direct impact on our health, but also on greenhouse gas emissions. The effects on greenhouse gas emissions impact diseases such as Malaria by increasing the temperature of our planet. The purpose of this research is to examine what gas flaring is, how it impacts the environment, and how that impacts malaria. This is to exemplify the impact we have on people's health around the world. Studies were done to assess the negative impacts that gas flaring has on the health of those living near oil drilling sites, as well as how it contributes to climate change. They compared health documents in six communities between 2013 and 2016, and collected primary data through surveys that asked residents a series of questions on how they believe their health is impacted by gas flaring. Research on how climate change impacts malaria is also examined. This study used progression data of malaria cases and the climate over the past 40 years to assess a correlation. They assessed the current state of malaria in Africa, and projected two scenarios of how malaria could spread throughout Africa by 2030, 2050, and 2080. The results of the first study show that those residing in areas near gas flaring sites in Africa are seeing increases in respiratory illnesses, eye irritation, chest pains, and asthma (Ryan et al., 2020). Rising temperatures due to climate change are projected to increase the transmission ability of malaria into new areas of Africa that have never carried the burden on this disease, as well as increase the severity and commonness of the disease

in areas where it currently resides (Ryan et al., 2020). Concluding that health is statistically impacted by gas flaring and climate change.

Introduction

Oftentimes we assume that our health is a matter of how much physical activity we do, what we eat in a day, and the genetics that have been given to us. However, the environment around us has a bigger impact on our immediate health than we might choose to acknowledge. Sometimes, what happens in the environment around us seems out of our control. It may seem too far from reach to inflict change, but being aware of the consequences of our actions can push us toward a solution. At oil drilling sites, there is often extra gas that needs to be eliminated. Due to the isolated location of these sites and the cost of transportation, this gas is often burned into the atmosphere. This causes repercussions on our health.

The purpose of this paper is to show how actions that are perceived as meaningless can have a large impact on human health. Gas flaring impacts the health of those living in surrounding areas, concentrates the air with pollutants, contributes to climate change, and thus causes a dramatic uproar in diseases where climate plays a critical factor, such as the vector borne disease malaria. Gas flaring has perceived economic and safety benefits, but also contributes to a variety of economic and production waste, as well as producing a high amount of pollutants such as sulfur dioxide and black carbon (Engineering & Picard, 2020). A causal sequence is that gas flaring can increase the risk of transmission of malaria for new populations in Africa. By stretching the limitation of the perceived consequences of

our actions, I hope to bring awareness to how our health is impacted by daily decisions that are sometimes out of our control.

Gas Flares

At an oil drilling site, you can often see a small flame at the top of a stack connected to the drilling system. That flame indicates gas flaring. Gas flaring is the act of burning natural gas, or a mixture of gasses during oil drilling (Global Gas Flaring Reduction Partnership, 2015). The mixture that is being burned can often be a combination of methane, processed gasses, fuel gas, steam, nitrogen, and natural gasses (Thurber, 2019). The composition of each mixture being burned varies by each company or location, and therefore it is difficult to definitively define. However, the gasses released during gas flaring are mainly natural gas, with more than 90% of it being methane (Baker Hughes, 2019).

Perceived Benefits of Gas Flaring

Economic

Gas flaring is performed for a number of reasons, including for economic and safety purposes. Regarding the financial aspect of why companies perform gas flaring, a major issue is that it is much more cost effective for companies to burn these natural gasses than to send it off for disposal or repurposing. Economically, it is more advantageous for companies to dispose of the gas themselves via gas flaring than to collect and move the gas (Schade, 2020). This gas has the capacity to be repurposed and used, but it would take a large financial effort to make it a reality. Companies would have to

contain and move the gas, as well as find a way to sell it. Since many of the sites where oil is drilled are in remote locations, the cost of transportation is extremely high. Overall, it is reasonable for companies to assume they would lose money in the process.

However, there are points that deem gas flaring as wasteful and a major economic loss. A study done through Texas A&M found that Texas has wasted as much gas each year due to gas flaring as Texans consume (Schade, 2020). They also reported that gas flaring in the Permian Basin resulted in $750 million worth of gas wasted in 2018 (Schade, 2020). This shows that there is a missed opportunity economically for these companies to repurpose or sell this oil.

Safety

While drilling, there is a large amount of pressure. Pressure is an element that needs to be controlled, and any sudden increase could have catastrophic effects. This pressure increase could result in explosions, fires, and the fatality of workers (Global Gas Flaring Reduction Partnership, 2015). Gas flaring is a way for drillers to depressurize the site and their equipment. This is used in emergency situations.

Negative Impacts of Gas Flaring

Waste

Not only has gas flaring resulted in a waste of precious gasses, but also a wasted business and financial opportunity for oil companies. 150 to 170 billion m^3 of gasses are flared each year (Emam, 2015). This

results in an estimated loss of $30.6 billion, which is comparable to 30% of gas consumption for the European Union, and 25% of gas consumption in the United States annually (Emam, 2015). The amount of gas that has been flared could have provided half of Africa's electrical needs (Emam, 2015).

Pollutants and Climate Change

It is easy to assume that burning natural gas will cause some adverse impact on the surrounding environment. Although it depends on the location, and the specific gasses that are being burned, gas flaring is shown to be a significant source of greenhouse gas emissions (Emam, 2015). There are a variety of pollutants that are released into the atmosphere from gas flaring. These include benzene, acetaldehyde, acrolein, formaldehyde, propylene, xylenes, ethyl benzene, and more than 50 other air pollutants (Earthworks, 2018). All of these toxins and pollutants directly impact us as humans.

The Niger Delta region has experienced the dramatic impacts of gas flaring. The burning of the gasses releases sulfur dioxide into the atmosphere (AAAS, 2011). High rates of sulfur dioxide in the atmosphere can lead to events such as acid rain, and contribute highly to greenhouse gasses (AAAS, 2011). Black carbon is also released during flaring, and contributes highly to global warming. Black carbon is a factor in 7 million people dying from air pollution each year (Engineering & Picard, 2020).

Overall Health Impacts of Gas Flaring

Studies have found that respiratory issues, skin/eye irritation, as well as cancer have been associated with exposure to gas flares in Canada (Gobo et al., 2010). Naphthalene is an agent that is found in particles of gas flares. Naphthalene is a hemolytic agent, meaning it destroys red blood cell membranes, and may cause cataracts (Earthworks, 2018). There are a number of pollutants that are released during gas flares that impact one's health. Nitrogen dioxide emphasizes the symptoms of asthma; alkanes such as methane, ethane, and propane result in swelling, itching, eczema, and acute lung swelling; aromatics such as benzene, toluene, and xylene are poisonous and carcinogenic. This means it impacts the nervous system and can potentially result in blood abnormalities (Emam, 2015). The pollutants released by gas flaring impact the airway and can trigger many allergies.

A study was done in the Niger Delta region of Nigeria to assess what risks could be posed to the respiratory and dermal health of the population due to gas flaring. They evaluated the spatial pattern of eight gas flaring sites, and wanted to see the health impact these caused. They conducted health profiling by evaluating the citizens' health and comparing the medical records of six primary health care centers from 2013 to 2016 for secondary data. They also distributed questionnaires to 200 homes living in the area as primary data. The questionnaire included both open ended and closed ended questions. The purpose of their study was to draw attention to the impact that gas flaring had on the health of the members of the community.

They collected air quality samples to determine the levels of CO, NO_2, and SO_2. They also compared the measurements between wet and dry seasons. There was a difference in the amount of pollutants in the wet and dry seasons, showing that environmental factors impact the concentration of pollutants. The concentration of pollutants varied within the eight areas, showing that there is a spatial and temporal variability (Nwosisi et al., 2021). This variation could be because some stations were closer together than others.

Overall, this study found that the amount of cases of respiratory ailment had increased over time in these areas from 2013 to 2016 (Nwosisi et al., 2021). The data found when assessing the primary care health center records showed that malaria, fever, cough, and headaches were the leading health problems in each community (Nwosisi et al., 2021). Issues such as difficulty breathing, coughing, eye irritation, asthma, chest pain, and dizziness are commonly related to air pollution (Nwosisi et al., 2021). These symptoms were frequent at each primary care facility source, but were highest in the areas where gas flaring sites were clustered. Malaria was also a leading health concern in these communities. In conclusion, this study found that there was a significant correlation between air pollutants, and the respiratory illnesses in the communities within the gas flaring sites.

Results from the surveys are included below, with the percentage of participants that said yes to experiencing the symptom.

- 81% believe the gas flaring sites have had a negative impact on their health.
- 52% have experienced eye irritation

- 54% said they had experienced nose irritation
- 89% said they had experienced breathing difficulties
- 90.2% said they have suffered from increased asthma

The scale of the percentages above supports evidence that gas flaring causes pollution, and is affecting those living near the source. The World Health Organization lists symptoms associated with air pollution as headache, difficulty breathing, coughing and sneezing, eye irritation, as well as nose, throat and skin irritation (World Health Organization, 2021). The majority of these symptoms were reported by participants of this study.

The Climate and Clean Air Coalition took time to interview people that are living in communities close to gas flaring sites. Community members reported that they feel a dramatic increase in difficulties breathing on days where flaring is being done. An interviewee by the name of Zakiya Kikia-Khan said that “It’s very scary: I feel choked up, I feel my lungs can’t get air, I feel starved of oxygen. I get panic attacks. I know my asthma would be better if I wasn’t exposed to it. I use my inhaler more often on days they’re flaring” in regard to how gas flaring has affected her (Engineering & Picard, 2020). The impact of the toxins released during flaring were seen in gardens after a day of gas flaring, as produce grew black. The release of these pollutants had a direct impact on the day to day life of people, not just the bioaccumulation of toxins in their systems.

Impacts that Climate Change has had on Malaria

Overview of Malaria

The CDC defines malaria as "a serious and sometimes fatal disease caused by a parasite that commonly infects a certain type of mosquito which feeds on humans" (CDC, 2022). It is common for malaria to be transmitted from mosquitoes. Not all mosquitoes transmit malaria, however. The ones that do transmit it are known as female Anopheles. The parasite that causes malaria is P. falciparum (Snow & Omumbo, 2006). This parasite infects a female mosquito. They spread the disease by sucking the blood of an infected person, and that blood has microscopic parasites of malaria. When the same mosquito bites its next host, it injects the parasite into said person (CDC, 2022). There are other ways this disease can be transmitted to a person, such as blood transfusions, being injected with a bloody needle used on someone with malaria, or other instances such as organ transplants (CDC, 2022).

Malaria initially can be misthought of as the flu because they have similar symptoms. Symptoms of malaria include chills, muscle aches, headaches, nausea, vomiting, and diarrhea. Malaria causes a decline in red blood cell counts leading to anemia or jaundice. Contracting malaria could result in kidney failure, seizures, coma and possibly death (CDC, 2022).

Malaria in Africa

Those residing in Africa make up a majority of the 435,000 deaths per year due to malaria (Ryan et al., 2020). Africa is disproportionately affected by malaria, and many efforts have been conducted to induce reduction. In 2020, 95% of people who were infected resided in Africa, along with 96% of

malaria deaths (World Health Organization, 2022). There are certain factors regarding climate that lead to Africa being heavily affected. Temperature is a determinant in the transmission of malaria, because the temperature range for the parasite is between 25 degrees Celsius and 30 degrees Celsius (Snow & Omumbo, 2006). Other factors that provide optimum conditions for transmission are rainfall and humidity. Africa provides the perfect balance of rainfall and temperature. Too much rain would wash away the eggs of Anopheles, and too little would not provide the moisture level needed for the eggs to survive.

Despite the efforts to reduce malaria in Africa, there was an increase of 3.5 million cases in 2017 (Ryan et al., 2020). There has been a continued increase reported in recent years. A study was done to assess the current malaria status in Africa, as well as the projected expectations. They found that the areas that are typically impacted by malaria in Africa will begin to expand due to shifts in the climate.

Scientists used a nonlinear physiological temperature-driven malaria transmission suitability model to assess malaria trends by temperature. They used 40 years of data to determine trends in humidity and temperature in Africa. The region was split up into 5 sections: northern, western, central, eastern, and southern Africa. Malaria is highly transmissible between the temperatures of 25 and 30 degree celsius, which is the temperature range of a large majority of Africa (Ryan et al., 2020). They assessed this temperature and compared it to malaria transmission rates per region. Using previous data, they used general circulation models to predict future climate in these regions. They projected these findings using two scenarios. One scenario was considered the “best case” scenario in which they reduced the

intensity of change to be below what is expected, while the other predicted the impact of rising greenhouse gas emissions. The times frames were predicted were 2030, 2050, and 2080. The reason they applied these assessments and predictions is because of the climate-transmission relationship with malaria.

Currently, central Africa is heavily concentrated with malaria, and is affected year round. Those living in western and eastern Africa are at risk for contracting malaria 7 to 9 months out of the year, while south Africa is too hot for mosquitos (Ryan et al., 2020). The Climate Change Scenarios showed that temperatures are expected to rise in all projected areas in all time segments (Ryan et al., 2020). With an increase in temperature, Anopheles will spread to areas that were not previously suitable for them. More malaria hotspots are expected to occur in central Africa, as well as shift to northern and southern Africa under all scenarios. Predictions show that 196 million to 198 million people in eastern and southern africa will be impacted by transmission risk by 2080 (Ryan et al., 2020). The worst-case scenario predicts that 73.4 million people will be at risk for year round exposure in eastern Africa, a place that was only seasonally impacted. 2.5 million people living in southern Africa, a place that is not typically heavily impacted by malaria, will be at risk for transmission year round by 2080 (Ryan et al., 2020). In eight years, 2030, this increase in temperature leads to an increased risk of malaria for 50.6 million to 62.1 million people at risk for year round exposure in southern, eastern and central Africa (Ryan et al., 2020). There are groups of people that have never been exposed to Malaria that will now have year round risk. Medical systems in certain communities have not had to fight this disease or work

to prevent this disease in the past, and many may be unprepared to deal with the burden this disease carries.

The increase in temperature, however, does not directly translate into a higher number of malaria cases. As previously discussed, there is a range of optimum transmission for malaria, and it is possible for temperature to be too high for transmission. Certain areas of sub-saharan Africa will decrease in malaria cases because temperatures will be too high for transmission. Although this means less exposure in those areas, a hotter climate does not improve health conditions.

Discussion

Gas flaring is something that most people do not know happens. It is a small action that causes a large impact further down the line. Gas flaring has a variety of impacts on our health, such as increased respiratory problems, skin and eye irritations, headaches, cancers, birth defects and so much more (Gobo et al., 2010). It also produces toxins and air pollutants such as sulfur dioxide and black carbon that contribute to greenhouse gasses and climate change (Engineering & Picard, 2020). Studies showed that there was a significant correlation between the rise in air pollutants and rise of dermal diseases in communities near gas flaring sites (Nwosisi et al., 2021). Therefore, not only is there a direct and immediate deterioration to our health from gas flaring, but it also contributes to greenhouse gasses which warm our planet, stretching the areas where vector transmitting diseases such as malaria effect. There are plenty more health consequences of climate change than malaria, but this serves as an

example that is not commonly discussed. This is to show that there may be a variety of diseases that are caused by simply a lack of knowledge of the impact of our own actions.

These chain of events show that the small actions we take have a larger impact on our health than we may have originally thought. Climate change does not just mean that glaciers are melting, but that temperatures are increasing and putting people at risk for diseases they have not been burdened with before. Although malaria is not a novel disease, it will be an emerging disease in areas that are ill prepared to deal with the weight of malaria cases. We have experienced first hand what it looks like to be overloaded with the burden of disease from COVID-19. Malaria is something that some are struggling with today and we should help others prepare for.

The results of these studies show that there are serious consequences to our actions, but it also allows the opportunity to induce change. This data proves that our actions make a difference, and thus reversing those actions will make a difference as well. Action has been taken to forbid routine gas flaring. In 2015, the World Bank announced the "Zero Routine Flaring by 2030" initiative which encourages all stakeholders to stop routine flaring (The World Bank, 2020). The goal of this initiative is to stop flaring in their own areas of jurisdiction, but to also encourage global change, which it did. Governments have assisted gas companies in the collection of this gas for utilization since this policy. The Global Gas Flaring Reduction Partnership is a company that assists developing countries with the disposal and removal of gasses which has encouraged other petroleum companies to take part in the reduction of waste.

Clearstone engineers have found a way to recover usable compounds from gasses that are typically flared. This finding will allow oil companies to reduce the waste of gas and increase their profits (Engineering & Picard, 2020). Not only is this beneficial for companies globally, but for the lives of those living near drilling sites. Oil companies are not intentionally wanting to harm those residing in nearby areas. They may just assume they are just burning waste. The Climate and Clean Air Coalition stated that "if these opportunities move forward they promise to not only help stem the onslaught of climate change but to make an immediate material difference in the conservation of oil and gas resources and the lives of people living around the oil and gas facilities" (Engineering & Picard, 2020). Although some companies have agreed to stop gas flaring, not every company is on board. Those that do take part in the "Zero Routine Flaring by 2030" initiative are not monitored either. Encouragement is still needed for oil drilling companies to stop gas flaring, and use the resources that are available to refine this gas.

Conclusion

The data collected exemplifies the harm that gas flaring does on the health of those living near gas flaring sites. It also provides evidence that the pollutants produced contribute to climate change. It is reasonable to conclude that gas flaring has a harsh negative impact on the human experience. Not only is gas flaring causing an economic disadvantage for business and wasteful, but is causing negative impacts on human health. Gas flaring is mainly conducted as a means of convenience, not of necessity. People living near drilling sites are experiencing painful symptoms from air pollution directly

correlated with the gas flares. Measurements have shown that the pollutants released from gas flaring are large contributors to greenhouse gas emissions leading to climate change. Reports have shown that climate change will increase the risk of malaria in places that have yet to suffer from it. Malaria is a disease that disproportionately affects Africa, and the trajectory of this disease is only expected to increase.

Gas flaring is sometimes necessary for safety measures to regulate pressures. However, routine gas flaring should be an action of the past, and it seems it is slowly becoming that way. More and more companies are beginning to stop routine gas flaring, but not all are taking part. There should be a continued call to action to end all routine gas flaring because it causes pollutants which harm human health through the air quality, as well as through climate change increasing the capacity for malaria. Oil companies that are still practicing gas flaring should consider utilizing the gas instead of burning it, not only for economic gain, but also to stop any potential harm done to others and our planet.

Resources

5 things you should know about flaring. Baker Hughes. (2019, October 5). Retrieved April 19, 2022, from https://www.bakerhughes.com/company/energy-forward/5-things-you-should-know-about-flaring

American Association for Advancement of Science (AAAS). (2011). *Eyes on Nigeria: Gas flaring*. American Association for the Advancement of Science. Retrieved March 15, 2022, from https://www.aaas.org/resources/eyes-nigeria-technical-report/gas-flaring#:~:text=Gas%20flaring%20introduces%20toxic%20pollutants,climate%20change%20(Obanijesu%20et%

Centers for Disease Control and Prevention. (2022, March 22). *CDC - Malaria - about malaria - faqs*. Centers for Disease Control and Prevention. Retrieved March 28, 2022, from https://www.cdc.gov/malaria/about/faqs.html

Emam, E. A. (2015, December 3). *Gas Flaring in Industry: An Overview*. Petroleum & Coal. Retrieved February 20, 2022, from http://large.stanford.edu/courses/2016/ph240/miller1/docs/emam.pdf

Engineering, C., & Picard, D. (2020, May 20). *Gas flaring has dangerous side effects but these mitigation opportunities could be a win for everyone*. Climate & Clean Air Coalition. Retrieved April 2, 2022, from https://www.ccacoalition.org/en/news/gas-flaring-has-dangerous-side-effects-these-mitigation-opportunities-could-be-win-everyone

Flaring and venting. Earthworks. (2018, February 5). Retrieved April 19, 2022, from https://earthworks.org/issues/flaring_and_venting/

Global Gas Flaring Reduction Partnership. (2015). *What is gas flaring?* World Bank. Retrieved March 6, 2022, from https://www.worldbank.org/en/programs/gasflaringreduction/gas-flaring-explained

Gobo, A., Richard, G., & Ubong, I. (2010). Health Impact of Gas Flares on Igwuruta / Umuechem Communities in Rivers State. *Journal of Applied Sciences and Environmental Management*, *13*(3). https://doi.org/10.4314/jasem.v13i3.55348

Nwosisi, Michael & Oguntoke, Olusegun & Taiwo, Adewale & Agbozu, Iwekumo & Noragbon, E.J.. (2021). Spatial patterns of gas flaring stations and the risk to the respiratory and dermal health of residents of the Niger Delta, Nigeria. Scientific African. 12. e00762. 10.1016/j.sciaf.2021.e00762.

Ryan, S.J., Lippi, C.A. & Zermoglio, F. Shifting transmission risk for malaria in Africa with climate change: a framework for planning and intervention. *Malar J* 19, 170 (2020). https://doi.org/10.1186/s12936-020-03224-6

Schade, G. W. (2020, August 3). *The problem with natural gas flaring*. Texas A&M Today. Retrieved March 6, 2022, from https://today.tamu.edu/2020/08/03/the-problem-with-natural-gas-flaring/

Snow RW, Omumbo JA. Malaria. In: Jamison DT, Feachem RG, Makgoba MW, et al., editors. Disease and Mortality in Sub-Saharan Africa. 2nd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2006. Chapter 14. Available from: https://www.ncbi.nlm.nih.gov/books/NBK2286/

Thurber, M. (2019, May 13). *Gas flaring: Why does it happen and what can stop it?* Energy For Growth. Retrieved March 6, 2022, from https://www.energyforgrowth.org/memo/gas-flaring-why-does-it-happen-and-what-can-stop-it/

The World Bank. (2020, August 21). *Zero routine flaring by 2030*. Zero Routine Flaring by 2030 - Climate Initiatives Platform. Retrieved April 9, 2022, from https://climateinitiativesplatform.org/index.php/Zero_Routine_Flaring_by_2030#:~:text=The%20%E2%80%9CZero%20Routine%20Flaring%20by,reservoir%20together%20with%20the%20oil.

World Health Organization. (2021). (rep.). *World malaria report 2021*. Retrieved March 9, 2022, from https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2021.

World Health Organization. (2022, April 6). *Fact sheet about malaria*. World Health Organization. Retrieved April 10, 2022, from https://www.who.int/news-room/fact-sheets/detail/malaria#:~:text=The%20WHO%20African%20Region%20carries,malaria%20deaths%20in%20the%20Region