

Living under a black sky

Conflict pollution and environmental health
concerns in Iraq

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Colophon

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PAX means peace. Together with people in conflict areas and concerned citizens worldwide, PAX works to build just and peaceful societies across the globe. PAX brings together people who have the courage to stand for peace. Everyone who believes in peace can contribute. We believe that all these steps, whether small or large, inevitably lead to the greater sum of peace.

If you have questions, remarks or comments on this report you can send them to info@paxforpeace.nl

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Cover photo: Nadak Aziz and Kharim Ali, a village elder and a young boy pose for a portrait near the Qayyarah oil fires. October 25th, 2016. Copyright Joey L/Oxfam.

1. Introduction

Over the last 30 years, armed conflicts have left a trail of death and destruction in Iraq. They have killed hundreds of thousands of people, and wounded many more, laying cities and towns to waste. The years of fighting have destroyed large swaths of agricultural land and woodland. They damaged industrial areas, creating hotspots of pollution. They crippled the healthcare system and critical infrastructure, and they severely degraded governmental capacity for industrial and environmental oversight. Following the US invasion in 2003, major efforts were undertaken to repair and rebuild the country, although these were often hampered by insufficient resources, insecurity and corruption. These factors meant that many environmental problems, such as the pollution caused by the wars, were neglected.

The slow process of recovery came to an abrupt end with the rise of the so-called Islamic State in Iraq and Syria (ISIS). With a ruthless campaign, ISIS overran large parts of northern Iraq, an advance that was only halted by a joint effort by the Iraqi government, in cooperation with the Popular Mobilization Units (PMUs): armed militias that followed the call by Grand-Ayatollah Sistani to defend Iraq. The Iraqi forces received air and logistical support from the US-led coalition's Operation Inherent Resolve. The years of intense fighting that followed caused severe damage to urban areas, while ISIS employed scorched earth tactics in their retreat to destroy natural resources, leaving a toxic legacy that will likely have long-lasting environmental and health consequences in affected areas.

Since the beginning of the campaign to defeat ISIS, PAX has monitored the environmental risks caused by the conflict using open-source methods. This has included publicly available satellite imagery from NASA and the European Space Agency (ESA), satellite data from Planet Labs, social media scanning and news articles; the aim being to identify and track environmental damage and its associated human health risks. This report is a summary of all the work we have undertaken during the last two years. It seeks to provide an overview of incidents where the conflict resulted in scenarios where pollution caused by the fighting could pose acute or chronic health risks for civilians. This can either be through direct exposure to the toxic remnants of war, or by affecting the environment that people live and work in. Research for this report is also based on field visits to northern Iraq, consultations with various UN agencies and humanitarian organisations operating in the affected areas, and a survey conducted in the Qayyarah area, which was heavily affected by oil well fires between 2016 and 2017.

The purpose of this report is to demonstrate that data collection on environmental risks can, and should, be undertaken during conflicts in order to improve humanitarian response and inform post-conflict reconstruction efforts. PAX also wishes to underline the need for community involvement in environmental assessments and reconstruction efforts. Lastly, the findings highlight the need for a structural, multi-disciplinary approach to identify, monitor and clean-up conflict-mediated environmental pollution, in order to minimise and mitigate the risks to the health and livelihoods of affected communities. ♦

2. Pre-existing environmental challenges in Iraq

Before the rise of ISIS and the ensuing conflict in 2014, Iraq's environment had already been heavily affected by climate change, weak environmental governance and the legacy of three wars. The country was relatively isolated from international assistance and cooperation on environmental issues between the 1980s and 2003.¹ Between 2003 and 2006, the United Nations Environment Programme (UNEP) undertook several projects to strengthen the capacity for environmental governance in Iraq. Throughout 2005, UNEP identified 60 pollution hotspots that were in need of remediation, five of which required immediate clean-up. In the years that followed, the Iraqi government attempted to address a number of environmental issues in cooperation with UNEP and the United Nations Development Programme (UNDP),^{2,3} and worked to improve domestic legislation on hazardous waste management, historical pollution, and climate change-related challenges.⁴

Climate change is thought to be responsible for an increasing frequency of droughts in Iraq during the last decade.⁵ Inadequate monitoring and ineffective governance have also impacted water management, resulting in wastage and pollution. Together with increased damming and upstream water use by neighbouring countries, the frequent droughts and increasing urbanisation have led to chronic shortages of water.⁶ As a result, salinisation and desertification have degraded large swaths of previously fertile land and water resources, in turn threatening drinking water supplies and agricultural yields.

With support from UNEP and UNDP,⁷ various plans have been created by the Iraqi Ministry of Planning,⁸ and the Ministry of Environment,⁹ to deal with these environmental problems, including toxic remnants of war, desertification, oil pollution and radioactive contamination. However, the extent to which these plans have been implemented remains unclear.¹⁰ During nationwide focus groups held by UNDP in 2013, which consulted with communities throughout the country, Iraqis expressed a number of concerns over environmental issues. They called for strengthened legislation to curb industrial pollution, the remediation of toxic waste from oil production and exploration, and the clean-up of radioactive pollution and other explosive and toxic war remnants.¹¹

Previous conflicts have left Iraq with a legacy of environmental pollution. Not only did those conflicts directly lead to the spread of hazardous materials through the destruction of industrial and military targets, they also undermined the government's ability to effectively monitor and

manage contaminated sites. The destruction of infrastructure, an influx of Syrian refugees - as well as its own internally displaced persons (IDPs), and the massive destruction of towns and cities have all contributed to the pollution problems Iraq faces. The past use of depleted uranium (DU) weapons, a radioactive and toxic heavy metal, has long-caused concern among communities and medical experts. DU was used by the US and the UK in ammunition during the wars in 1991 and 2003, and was fired at more than 1,100 locations, including in densely populated areas.¹² Its use also generated hundreds of DU contaminated military vehicles, which were improperly managed at scrapyards across Iraq. The absence of transparency over DU use by the US, and inadequate remediation efforts and awareness-raising measures, have only added to existing anxieties and a lack of faith in the government's ability to effectively deal with the environmental pollution caused by the conflicts.¹³ ♦



Military scrap metal being recycled by Kurdish workers, Qushtapa, Kurdistan region, Iraq, September 2003. The tanks were imported from southern Iraq.

3. Environmental legacy of the fight against ISIS

As the fighting in Iraq recedes, the destruction it has left in its wake is becoming more visible. This chapter provides an overview of the areas affected by both ISIS's destructive policies, and the operations by the coalition and the Iraqi government to defeat them. In September 2017, UNEP's Post-conflict and Disaster Management Branch (PCDMB) released an initial assessment of pollution issues in areas retaken from ISIS. In addition to the well-documented pollution problems from the Qayyarah oil fires and the Mishraq Sulphur Plant, the report also highlighted the risks from damaged ISIS ammunition manufacturing plants; polychlorinated biphenyl (PCB) contamination from attacks on energy infrastructure; the environmental challenges posed by the vast quantity of debris and waste; and concerns over the large quantities of asbestos present at various sites in Mosul.

The report also noted that the collapse of environmental governance and the destruction of environmental research laboratories will likely have a long-term impact on recovery and reconstruction efforts. Finally, the report noted that the weaponisation of water management infrastructure had created severe security risks through flooding, and had contributed to long-term socio-economic pressures by degrading agricultural lands. Further work on the identification of pollution hotspots is expected to be undertaken by the Iraqi Minister of Health and Environment, with support from the UN.

With the data that PAX has collected in the last three years, we aim to add to the existing body of knowledge on potential sources of pollution, and in so doing help inform the work by the relevant authorities to undertake research at these locations, and the remediation of these sites if contamination with toxic or hazardous substances is confirmed.

3.1 The toll of oil fires

Oil industry activities involve the handling of dangerous chemicals and hazardous by-products. In Iraq, refineries were already a local source of pollution due to inadequate governance and control measures. However, the recent conflict has turned oil and gas industry facilities into a major source of health and environmental risks. Refineries, tanks, pipelines and oil fields have been tapped for their income potential by both militant groups and local people. Airstrikes by the US-led coalition targeted the oil industry in order to deprive ISIS of oil-revenue, mainly by targeting hundreds of oil trucks.¹⁴

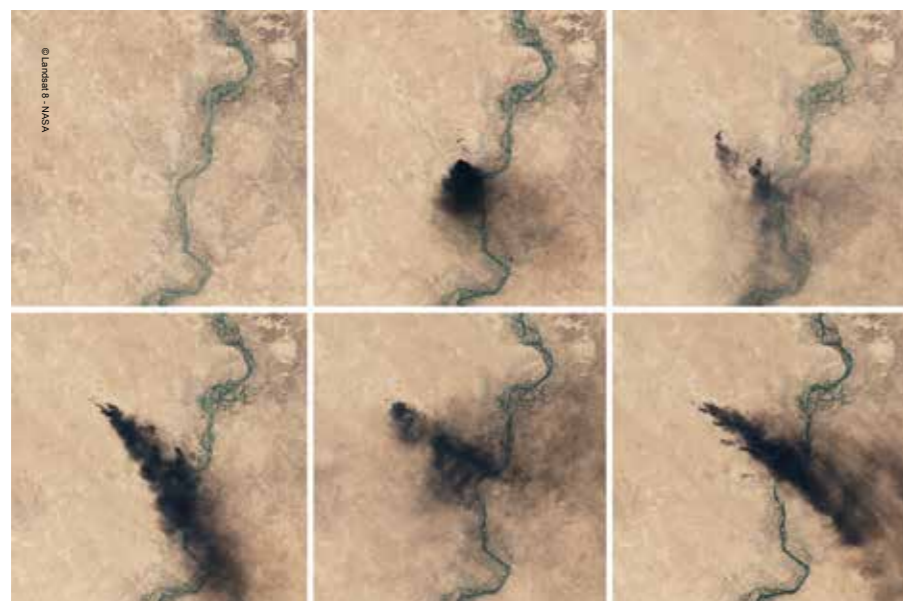
Moreover, as Iraqi forces regained territory from ISIS, the group employed scorched earth tactics by setting alight oil wells. The resulting oil spills, fires and smoke clouds have caused immense harm to the environment. Without access to functioning oil facilities, ISIS and communities began to use artisanal oil refining methods to produce petrol and diesel. The following chapter considers the different ways through which the conflict and the oil industry have contributed to the deterioration of Iraq's environment, and the means through which this is creating health risks for Iraqi communities.

As ISIS retreated from areas that it held, they often set oil wells and rigs on fire in order to provide cover from aerial bombardment, delay Iraqi forces or simply to degrade valuable resources, land and infrastructure and terrorise communities.¹⁵ The resulting smoke plumes from the wells obscured the sun for months, leading locals to refer to it as the "Daesh Winter".¹⁶ Our research has identified four major oil producing areas affected by the conflict:

AL-QAYYARAH

Before the conflict began in 2014, the Qayyarah oil field had a production capacity of 30,000 barrels per day (bpd), and there were plans to increase its daily output to 120,000 bpd.¹⁷ After ISIS captured the field in 2014, they decided to exploit it for revenue, smuggling crude oil across the Turkish border.¹⁸ In May 2016, UNOSAT detected fires at several wells around Qayyarah, which continued to burn intermittently until June. Then, in July 2016, as Iraqi forces began their operation to retake Qayyarah, the fires greatly increased in number and duration.¹⁹ In September, when the Iraqi army recaptured the field, ISIS had set alight 20 wells as they retreated.²⁰

Analysis of satellite imagery carried out by UNOSAT showed that smoke from a large number of the fires was depositing soot over Qayyarah, as well as over a large area surrounding the town.²¹ Some of these fires burned for nine months, releasing vast quantities of toxic residues into the air, while the fallout of soot covered the surrounding towns and land with a black blanket.²² Efforts by Iraqi firefighters to extinguish the burning wells were complicated by mines and IEDs left behind by ISIS. At the end of March 2017, the last well was extinguished, leaving a blackened and contaminated landscape.



Burning oil wells at Qayyarah oil field between May and August 2016.

The health and environmental risks of oil fires

Oil fires release harmful substances into the air,²³ such as sulphur dioxide, nitrogen dioxide, carbon monoxide, polycyclic aromatic hydrocarbons (PAHs), particulate matter and metals such as nickel, vanadium and lead. The nitrogen and sulphur compounds are associated with acid rain, which can have a negative impact on vegetation and lead to the acidification of soils. Furthermore, these substances can cause severe short-term health effects, especially for people with pre-existing respiratory problems. The large-scale release of PAHs can have a potentially severe long-term environmental impact. PAHs are very persistent organic compounds, some of which are carcinogenic and can cause respiratory problems. When released by fires, they can be transported over a large area before deposition in soils. This, in turn, affects the health of civilians in affected communities.²⁴ Metals released by fires are also environmentally persistent, and prolonged exposure can cause a range of health effects.

HAMRIN MOUNTAINS

The Alas and Ajeel fields oil in the Hamrin mountains were also captured by and set on fire by ISIS. ISIS's capture of the Alas in 2014, led to a long-running struggle with Iraqi forces for control over the field. The group set its wells ablaze on several different occasions when they were being pushed back.²⁵ The most recent example of these tactics was in September 2017, when ISIS fell back and set several wells on fire.²⁶ Satellite imagery from the ESA shows that large plumes of dark smoke have been rising from the Alas oilfield intermittently from at least August 2015 until November 2017.^{27, 28}

The other major field, called the Ajeel or Ajil oil field, which has the capacity to extract 28,000 bpd, was also captured by ISIS, who began selling its crude in June 2014.²⁹ When ISIS was forced out by Iraqi forces in March 2015, they set fire to several wells. Since then, ISIS has carried out several other counter-attacks.³⁰ As with the Alas field, satellite imagery shows that some of the wells were still burning at the time of writing.³¹

BAJI OIL REFINERY

As Iraq's largest oil refinery, Baiji has been intensely contested. It had been producing up to 200,000 bpd; a third of Iraq's domestic production.³² Chemical pollution could be found at the refinery in 2013, likely caused by limited protection and control measures.³³ ISIS attacked it for the first time in June 2014, setting fire to several storage tanks.³⁴ Fighting for control over the refinery was ongoing until April 2015 when it was eventually overrun by ISIS.³⁵ A large-scale counter offensive by Iraqi forces managed to drive ISIS out six months later, with air support targeting various locations on the oil refinery itself.³⁶ As the militants fell back, they set fire to oil tanks, key infrastructure, and detonated explosives, severely damaging the facility.³⁷ Although it was initially reported that the site was damaged "beyond repair",³⁸ the Iraqi government plans to repair and start-up parts of the refinery by 2018.³⁹



Satellite imagery showed fires burning at Baiji oil refinery. Apr. 18, 2015.

ATTACKS ON KIRKUK'S OIL INFRASTRUCTURE

The oil rich Kirkuk governorate has faced numerous attacks since the rise of ISIS in the area. Dozens of articles documenting them have been published by Iraq Oil Report,⁴⁰ a specialist news organisation reporting on Iraq's oil industry. Over the last three years, there have been attacks on wellheads, oil pumps, gas plants, refineries, and oil and gas pipelines, which have all likely contributed to spills and localised pollution. In July 2016, militants caused severe damage to the largest oil field in the area, Bai Hassan, by detonating explosives and setting oil storage tanks ablaze; also damaging a nearby gas plant in a simultaneous attack. In recurrent attacks on Bai Hassan, ISIS blew up an oil well in August 2016,⁴¹ and continued attacks on other oil infrastructure in the area throughout 2017.⁴²

3.2 Environmental pollution from oil spills

Oil production and smuggling provided ISIS with a significant income, encouraging their attempts to gain control over the oil fields of northern Iraq. However, before some fields were taken, some wells were rendered inoperable by Iraqi oil technicians, and ISIS's lack of professional equipment and expertise resulted in failed attempts to extract crude oil. Aside from the fight for control over these oil refineries and wells, ISIS also frequently targeted oil installations in Kirkuk with suicide attacks. UN Environment's preliminary assessment revealed that large tracts of farming and grazing land have been affected by oil pollution,⁴³ not only directly threatening the health of local communities and their livestock, but also their livelihoods.

Health and environmental risks from oil spills

Oil spills from damaged wells, refineries, trucks, tanks and pipelines can not only harm the soil immediately surrounding the spill but can also pollute ground and surface water, subsequently threatening drinking water sources and agricultural land. In turn, this can expose people and livestock to chemicals found in crude oil, such as BTEX, PAHs and heavy metals. Depending on the duration and intensity of this exposure, health issues that may arise include liver and kidney problems, respiratory disease, and cancer. Spills release a range of hazardous Volatile Organic Compounds into the air as the oil dries out.

QAYYARAH

The struggle for control of the oil field and refinery at Qayyarah, and the subsequent fires caused major oil spills around the wells at various points in the oil field.⁴⁵ ISIS also pumped heavy crude directly into the River Tigris. Local witnesses said that crude oil was clearly visible polluting the irrigation channels of nearby farms.⁴⁶ The population of Qayyarah relies on the Tigris for its drinking water.⁴⁷ Oil also flowed through the streets of Qayyarah after ISIS opened pipelines, and some neighbourhoods remain highly contaminated with oil sumps.⁴⁸ At other wells, large lakes of solidified crude oil formed, which now require clean-up. The total amount of burned and spilled oil cannot be ascertained but it is estimated by experts from the oil ministry at 20,000m³. Several storage tanks were flooded in pools of liquid oil, which is likely to have seeped into the ground.⁴⁹



Large oil spills near the town of Qayyarah. In the background, oil wells burn. Jan. 31, 2017.

HAMRIN OIL FIELD

Failed attempts by ISIS to extract crude oil from sealed off wells, and fires at unsealed wells, resulted in oil spills in the Hamrin oil field. The largest oil spill was detected by PAX via ESA's Sentinel 2 satellite. The oil flowed from the hills into the valley and formed a roughly 11km long spill. Verification was undertaken in cooperation with Iraq Oil Report's network of contacts in the area, who provided footage of a river of crude oil flowing over agricultural land. Local people have expressed concern over the pollution, and its associated health and environmental risks.⁵⁰ Other hotspots of localised pollution will likely be found near the oil wells in the Hamrin hills, some of which have been burning for more than two years. Further verification on the ground is needed to assess the magnitude of these spills, and their environmental impact. Cleaning up spills is costly. Historic cases indicate that the costs for Iraq's oil fields will likely amount to hundreds of millions of dollars.⁵¹



An 11km long oil spill at the Hamrin oil field. Aug. 5, 2017.

OIL SPILLS FROM DAMAGED PIPELINES

Pipelines have been targeted frequently during the conflict, and have caused huge spills when breached. The main pipeline for Iraqi oil exports to Turkey (ITP) was bombed, on average, once a week in 2013 alone.⁵² In 2014, a pipeline near the Tigris was bombed, which resulted in a 70km long oil slick.⁵³ In order to reduce the pollutants in the water, the oil was set on fire, generating black clouds and a persistent haze. Residents downstream on the Tigris were told not to use their tap water for three days, and cities like Baghdad closed off their water supply from the Tigris until the slick had passed. Throughout the conflict, pipelines have also been targeted for revenue purposes. ISIS's early oil trade largely depended on tapping pipelines.⁵⁴ In August and September 2017, several smuggling operations were uncovered, one of which was capable of tapping thousands of barrels of oil per day.⁵⁵ These illicit operations involved plastic hoses several kilometres in length, underground storage tanks, and pumps originally used for agricultural purposes.



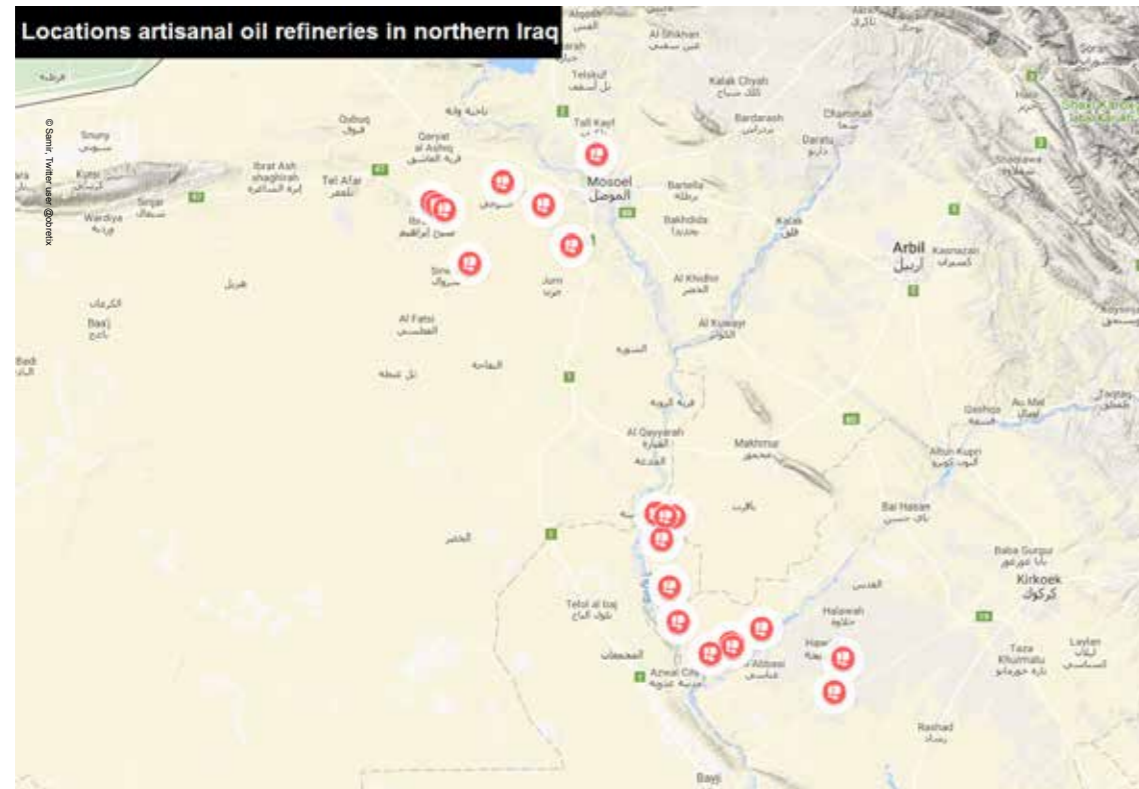
Residents look on as oil leaks into the Tigris River while smoke rises in Tikrit, north of Baghdad, Apr. 17, 2014. A pipeline that runs from the Kirkuk oilfields to the Baiji refinery leaked a large amount of oil into the Tigris River after being bombed. The spill stirred panic after someone set the oil ablaze, sending huge clouds of smoke into the provincial capital Tikrit, according to city residents. Ambulances evacuated residents with difficulty breathing.

3.3 The rise of artisanal oil refineries in northern Iraq

Professional refineries were taken out of production during the fighting, yet oil products were still in demand. In neighbouring Syria, this led to the enormous growth of artisanal oil refineries. Research by PAX identified at least 20,000 of these makeshift oil installations in 2016, in 30 clusters in north-east Syria. Current estimates suggest that there are now more than 50,000 artisanal refineries in 60 clusters. Similar practices also began to emerge in ISIS-occupied areas of northern Iraq in early 2015. Over the course of three years, PAX has identified at least 20 clusters, hosting more than 1,600 refineries.⁵⁶ The largest was located south of Mosul, where more than 600 artisanal installations were found, together with some smaller clusters west of this location. Four other major sites, some with more than 100 installations, were located north-east of Tel Afar. In Hawijah, numerous smaller clusters were found in the hills and along the roadside east of the Tigris, with a larger site at a former Iraqi army base close to Hawijah town.

Producing fuels using artisanal refineries requires working in extremely unhealthy conditions. In Syria, various anecdotal reports from Hasakah and Deir ez Zor Province note the serious health problems workers, many of whom are children, face at these refineries. These range from acute risks from exposure to toxic waste, to concerns over health problems such as cancers and respiratory illnesses from chronic exposure to hazardous chemicals and inhaling crude oil fumes. ♦

4. Damage to urban areas



Overview of locations where PAX has identified clusters of artisanal oil refineries.

Cities have played a central role in the conflict in Iraq. During the intense sieges airstrikes, attacks with Vehicle Borne Improvised Explosive Devices (VBIEDs) and artillery levelled entire neighbourhoods, as well as industrial areas in cities like Mosul and Ramadi. Of these, Mosul has received the most attention due to it being one of the most populous cities in Iraq before ISIS captured it. Combat in urban environments can create long-term environmental health risks. Industrial sites, both large and small, and which store or process toxic chemicals, are often situated in or near populated areas. Critical infrastructure, such as power and water networks also contain toxic materials, and can create hazardous waste when damaged. Moreover, the millions of tonnes of debris and rubble produced by the destruction of residential and commercial areas presents a major challenge for clean-up, as they may include mixed forms of solid and hazardous waste.

4.1 Debris

When explosive weapons hit buildings and structures, there is a direct release of particulate matter. This may be comprised of a mixture of concrete, cement – and its impurities, and sometimes asbestos, all common building materials in Iraq. This can lead to environmental contamination and present a human health hazard, especially when inhaled over long periods of time.⁵⁷ In Iraq, the destruction of buildings will also have to continue after the conflict has passed, as ISIS deliberately sabotaged the structures of buildings, many of which now require demolition.⁵⁸ Managing the debris resulting from the destruction of entire city blocks also carries risks. Removing them will inevitably create more dust clouds, and workers will also have to deal with unexploded ordnance as well as IEDs.⁵⁹ The cost of transporting the 10 million tonnes of debris out of Mosul alone is estimated at US\$250million.⁶⁰

Damage assessments by UNOSAT of other cities such as Ramadi and Fallujah have revealed the extent of destruction. A video released by the International Committee of the Red Cross showed whole neighbourhoods in Ramadi reduced to rubble.⁶¹ The organisation claims it will take months to repair electrical and water systems. Satellite imagery shows the conflict's devastating impact on Ramadi's population, buildings and electricity networks.⁶² In Fallujah, even though the level of destruction is not as severe as in Ramadi, the direct environmental pollution from the conflict is still apparent. Similar to other cities that fell under the control of ISIS, destroyed buildings and debris are common. Furthermore, there are also sites that were used as weapons production and storage facilities, practices that often generate toxic waste by-products.⁶³



A patchwork of rudimentary oil refineries - set up under ISIS and now abandoned - in the Khafsah area south of Mosul, Feb. 23, 2017.

The Iraqi government will need to deal with millions of tonnes of rubble and debris generated by the intense fighting that took place in these cities. Often the rubble is mixed with unexploded ordnance, household, industrial or medical waste, adding an extra health and environmental risk dimension to remediation efforts and safe disposal measures. Reconstruction will increase demand for new building materials. Despite being banned under Iraqi environmental law, municipalities are proposing to extract sand and gravel from the Tigris. This kind of riverbed quarrying is highly destructive and would place even more strain on the environmentally sensitive Tigris.⁶⁴



A displaced Iraqi man carries a child along a street covered in debris as the battle between the Iraqi Counter Terrorism Service and Islamic State militants continues nearby, in western Mosul, Iraq, April 23, 2017.

MILITARY REMNANTS

Vast quantities of munitions have been fired in urban areas, which apart from their explosive impact could have long-term health and environmental consequences.⁶⁵ Localised pollution risks can occur from residues from weapons that function correctly, and from unexploded ordnance. Munition compounds such as DNT, RDX, PBX and TNT, and heavy metals, are all toxic. The use of white phosphorous was also documented in Mosul.⁶⁶

Damaged or destroyed military vehicles present another exposure pathway for military toxics, in particular for scrap metal workers or children, who may play on them. Tanks and armoured vehicles contain toxic PCBs, asbestos and other hazardous materials, and have previously been identified by UNEP as a pathway for civilian exposure to toxic remnants of war.⁶⁷

4.2 Critical infrastructure

Power stations, transformers, and other parts of the power grid were targeted by all parties to the conflict. Although they are being phased out globally, old electrical transformers often contain oils containing PCBs. PCBs are a group of persistent organic compounds, exposure to which has been linked to birth defects, slower mental development in children, and cancer.⁶⁸ In Mosul, the fighting has severely damaged the electrical network. With numerous damaged or destroyed substations and transformers, there is a substantial risk of PCB contamination.⁶⁹ Clean-up will be slow as ISIS booby trapped electrical facilities to hinder reconstruction efforts.⁷⁰ Other locations with damaged power facilities include Diyalah governorate,⁷¹ and the town of Samarra.⁷²

4.3 Damage and decline of water infrastructure

Water systems, such as the Fallujah Barrage, the Mosul Dam, and the Haditha Dam, have been at high risk of damage due to the ongoing fighting and a lack of essential maintenance. ISIS intentionally damaged dams, hydroelectric power plants and barrages with the aim of using the environment as a weapon of war. For example, ISIS flooded some areas in order to disrupt the movement of ground forces, and shut the water supply off to others.⁷³ As the group retreated, they blew up bridges, which blocked canals, and destroyed pumping stations.⁷⁴ They also focused on minor parts of the network such as wells and pipelines,⁷⁵ disrupting and destroying agricultural livelihoods and placing entire communities at risk by depriving them of water and the electricity generated by dams. The damage of these actions has been estimated by the Iraqi Ministry of Water Resources to be around US\$600million.⁷⁶

Apart from the damage caused to water infrastructure, ISIS also directly contaminated water sources. The group used the Tigris as a mass grave, on one occasion dumping at least 100 bodies into the water.⁷⁷ Furthermore, ISIS deliberately poisoned lakes, rivers and streams with oil products and toxic waste.⁷⁸ For example poisoning wells in their retreat by dumping diesel into them, rendering it toxic for humans, plants and livestock.⁷⁹

The water insecurity that plagued Iraq before the conflict has not eased since. Upstream neighbouring countries, already in dispute with Iraq over water before 2014, have taken advantage of the civil war and severely limited the amount of water flowing downstream into Iraq. Climate change has taken its toll as well, with rainfall patterns becoming increasingly unpredictable. The Minister of Agriculture of the Kurdish Regional Government has already stated that fewer than 60% of farmers are receiving enough water.⁸⁰ Recent reporting also suggests that the climatic and governance problems that led to the decline of agricultural lands functioned as a recruiting mechanism for ISIS. They offered financial support to poor farmers, providing them with an alternative income if they joined the terror group.⁸¹

4.4 Industrial sites

MISHRAQ SULPHUR PLANT

The Mishraq Sulphur Plant has been set on fire before: in 2003 a deliberate fire produced “the largest non-volcanic release of sulphur dioxide ever observed with satellites”, releasing roughly 600 tonnes of sulphur dioxide.⁸² In 2016, ISIS also set fire to stockpiles of sulphur at the plant

near Mosul. The toxic smoke plume resulted in the hospitalisation of more than 1,000 people, 20 of whom died.⁸³ Satellite imagery clearly showed the white sulphur plume spreading over a vast area. NASA measured sulphur dioxide in the atmosphere across the entirety of northern Iraq, as well as over eastern Syria and parts of Turkey.⁸⁴ The acidic gases and rain stemming from the plume may have increased the acidity of open bodies of water, and damaged vegetation.⁸⁵

AL-HEKMA PHARMACEUTICAL COMPLEX

According to the US Air Force's Central Command, a large pharmaceutical complex five kilometres north of Mosul was used as a chemical weapons plant, producing mustard gas and chlorine.⁸⁶ As it was subsequently targeted by coalition airstrikes, it is conceivable that harmful substances were released into the environment from this location.

AL QAIM PHOSPHATE FACTORY

Airstrike footage released by the coalition showed the bombing of the phosphate factory near Al Qaim,⁸⁷ which was allegedly being used by ISIS to create VBIEDs. Before the conflict, the factory produced more than 650,000 tonnes of fertilisers, as well as other chemicals, such as 400,000 tonnes of phosphoric acid,⁸⁸ which can cause moderate injuries even after short exposures.⁸⁹

CONCERNS OVER LOOTING AT INDUSTRIAL SITES

History suggests that the looting of industrial sites could be another health and environmental threat. Following the fall of the regime in 2003, several tonnes of cyanide salts were looted, dumped and burned; 70 tonnes of pesticides were stolen and likely mishandled; and hundreds of drums containing radioactive uranium oxide ended up in the hands of local people, who used them to store drinking water.⁹⁰ In 2016, when the Iraqi army and the PMUs regained control over the Baiji refinery from ISIS, it was expected to be restored within months. Since then, the systemic looting of spare parts, heavy equipment, lubricants and generators has taken place "on an industrial scale"; and the cost of repairs is now estimated at US\$12billion.⁹¹ There have also been unconfirmed reports of militias looting factories in the industrial area of Mosul.⁹² ♦

5. Wider environmental impacts of conflict

A part from the direct impact from military activities and civilian practices that could create pollution risks, the conflict brought with it a range of other environmental challenges for Iraq's population and their future.

5.1 Refugees and internally displaced persons

According to the International Organisation for Migration, Iraq currently has more than 3.1 million IDPs.⁹³ As ISIS captured cities such as Mosul and Tikrit, hundreds of thousands of people fled to Iraqi Kurdistan for its relative safety. The influx of IDPs was enormous, to the extent that as early as June 2014, relief workers from the United Nations Refugee Agency warned that the temporary refugee camps were overcrowded. The surge of IDPs, as well as Syrian refugees, overloaded municipal systems and infrastructure in the Kurdistan region. As the region became more densely populated, there was a greater demand for resources such as water and electricity, and a simultaneous increase in the output of waste and pollution. This was underscored both by the World Bank,⁹⁴ and by the Kurdistan Regional Government, which highlighted the need for improved sanitation, infrastructure, water and waste collection.⁹⁵ A UNDP-funded post-conflict environmental assessment from 2015 identified a range of environmental issues affecting IDP camps, noting an increase in solid waste management issues such as dumping and burning, the depletion of water resources in specific areas, and the potential for an increase in severe air pollution through increased emissions in the Kurdish region.

5.2 Changes in agricultural lands

According to the United Nations Food and Agriculture Organisation, roughly one-third of Iraqi livelihoods depend on agriculture, even though it only makes up just 5% of Iraq's GDP.⁹⁶ Crop production comprises 75% of the Iraqi agricultural sector, with cattle herding, fishing and beekeeping making up the remainder. Crop production has suffered heavily as a result of the conflict. The contamination of fields with unexploded ordnance and mines, the displacement of farmers, the looting and burning of silos and other facilities, the lack of fertilisers and seeds, and the collapse of government support, have all had a severe impact on farm yields.⁹⁷ Animal husbandry, an important source of income and food, particularly for female-headed households,

has also suffered. It is estimated that, three quarters of all cattle, sheep, goats and buffalo have been lost.

Initial reports raised fears over the agricultural livelihoods of farmers in Iraq and Syria. Shortages of fuel, electricity, water, fertiliser, the lack of access to land, as well as the general uncertainty created by the conflict were preventing farmers in ISIS-controlled zones from planting their seeds.⁹⁸ Despite these early concerns over the impact of the conflict on agricultural production, research has shown that high-intensity farming actually increased in areas under the control of ISIS, in contrast to other areas in Iraq.⁹⁹ Other research has shown that from 2014 to 2016, agriculture was an important source of revenue for ISIS, which can potentially explain why production was stimulated.¹⁰⁰ In spite of the fact that agricultural production fared better in ISIS-controlled areas than outside these zones, satellite imagery shows that once the Iraqi government regained control over cities like Tikrit and Ramadi, agricultural activity surrounding those cities significantly increased.¹⁰¹ Other reports from Sinjar indicated that ISIS destroyed large areas of agricultural land and woodland as retaliation against the local population.¹⁰² ♦

6. Perceptions of pollution: Community concerns in Qayyarah

6.1 Context

While the burning oil wells and severely damaged industrial sites were a visual magnet for the media, vividly showing the toxic horrors of war, interest in the long-term health consequences of exposure to conflict pollution soon faded after the fires were extinguished. Although the journalists have moved on, the people living in areas where these toxic remnants of war are present will have to face the aftermath of the conflict's environmental legacy: air pollution from the burning wells; oil soot that spread over a vast area, covering soil and affecting livestock; groundwater pollution; and crude oil and wastewater spills.

In Qayyarah, thousands of local people, and more than 35,000 IDPs in the nearby camps, lived under the dark cloud that blocked out the sunlight for months.¹⁰³ Reporting from numerous media sources and international organisations highlighted concerns expressed by the area's inhabitants over the health effects of the oil fires, yet we found no evidence of risk education programmes or awareness-raising initiatives targeted at affected communities. In April 2017, the UNDP, together with PAX's local Iraqi partner the Al Tahreer Association for Development, conducted a survey on the environmental concerns of people in and around Qayyarah. As part of this survey, PAX provided input for questions on the wider environmental concerns in Ninewa Governorate.

PAX's community engagement in Ninewa Governorate

Since 2015, PAX has been supporting the establishment of local citizen platforms in Ninewa, in order to facilitate community engagement in government reconstruction planning following the retreat of ISIS. Citizens in these platforms, representing the diverse ethnic and religious communities of Ninewa, all highlight the many years of marginalisation of Ninewa Governorate by the Baghdad government. Moreover, the fact that territory in Ninewa is part of the Disputed Internal Boundaries between the Government of Iraq and the Regional Kurdistan Government, has led to administrative uncertainty and competition between parallel (Kurdish and Iraqi) authority structures.

Within this context, citizens of Ninewa show a record low level of trust in political leaders - both at the regional and national level - to respond to their needs. They have therefore called for increased engagement from the international community in reconstruction efforts, taking into account the various conflict sensitivities in Ninewa. PAX advocates for the inclusion of the perspectives and concerns of Ninewa citizens in any post-conflict reconstruction plan, and in post-conflict environmental assessments. We also seek to highlight the role that Iraqi civil society can play in conflict sensitive environmental policies, and in providing oversight on the spending of reconstruction funds.

The survey created two focus groups for interviews in the Qayyarah District. Group 1 consisted of 11 women aged between 18 and 25, while Group 2 comprised 10 women aged between 25 and 35. The aims of the survey were to document perceptions about the environmental pollution caused by the conflict, views about the health problems reported in communities, and to reveal where the community felt that responsibility should lie for remediation. The results highlighted the importance that the communities attached to the management of the pollution and wider environmental problems caused by the conflict. The following section briefly summarises the outcome of the survey by topic.

6.2 Environmental change

Participants were asked for their views on whether and how the conflict has affected the environment in the area. Both focus groups expressed concern over pollution in the soil, water and air in Qayyarah caused by the oil well fires, the Mishraq sulphur fire and military remnants. Crude oil leaking into the soil and affecting groundwater was often mentioned, as was the dumping of corpses into the river. Some raised concerns over the remnants of chemical weapons, in particular, mustard gas, and other toxic substances derived from munitions, as well as the targeting of industrial sites that could have dispersed hazardous materials. Air strikes on ISIS targets in residential areas were also viewed as a source of pollution, with chemicals that could have affected soil and groundwater.

According to some of the respondents, vast areas of agricultural land south of Mosul have been

affected by desertification as a result of neglecting agriculture and irrigation for the last three years, affecting the environment, the local population and livestock.

6.3 Health concerns

All participants expressed grave concern over the health risks associated with conflict pollution. They recalled the stories from people living near the burning wells who had inhaled the smoke, and who reported cases of suffocation and respiratory problems; with some requiring oxygen treatment. Others mentioned that local health officials had told them that the pollution might have short-term consequences such as allergies and shortness of breath, as well as long-term consequences such as lung cancer and pulmonary fibrosis. Participants in Group 2 expressed more serious concerns, with one participant stating that: "Locals have been suffering from burns, deformations and countless disability cases. Human genes are also affected due to the use of chemical weapons and the burning of oil wells and military remnants. The gene mutations will result in having more birth defects."¹⁰⁴

The groups also noted that there is a strong socio-economic dimension to the health problems. Group 2 noted that: "The most affected ones are the low-income families and chronic disease patients. Due to the pollution, locals are facing more economic burdens. Suffocations, respiratory problems, rash and allergy cases increased, making it difficult to afford the treatments costs". There is also a lack of treatment in the area, which forces many locals to seek medical help in other cities. The pollution was said to impact the lives of humans, animals, plants and property, thereby affecting the well-being of people living in the affected areas.



Families in Qayyarah live in homes covered in thick black soot; a result from burning oil wells. November 2016.

6.4 Indirect consequences

In addition to the direct health consequences, pollution of the environment is also perceived by the participants to have had other long-term effects. The pollution and fallout from the oil fires destroyed large areas of cultivated and grazing land, and has killed livestock. This directly affected livestock breeders and farmers, who lost access to their sources of income.

6.5 Remediation and risk education

Addressing community concerns and the provision of medical care was of great importance to both groups interviewed. They suggested there should be a joint effort by the government, in cooperation with scientists, environmental organisations and individuals to tackle the pollution. More importantly, appropriate medical treatment and health services should be provided to those affected by the Iraqi government, with the support of specialised international organisations. And if local treatment is not possible, patients should have the opportunity to receive treatment abroad. They suggested that a health monitoring system, or health committees, be established in order to swiftly identify people who have been affected by the pollution.

The groups also felt that environmental pollution needed to be addressed by identifying sources, and beginning clean-up operations. The pollution caused by the oil fires, and the hazardous debris from damaged industrial sites, were viewed as a priority. One suggestion provided was to surround the polluted areas with plants, to form a protective belt of trees to prevent the spread of pollutants. Other participants suggested the development of laws to limit the use of weapons that release pollution and radiation. Lastly, they also called for risk education campaigns to be undertaken in the Qayyarah area to educate local communities on the pollution hazards. ♦



Sheep covered in oil soot are grazing near a burning oil well, Qayyarah. January 2017.

7. Conclusion and key findings

Since the armed conflict in northern Iraq began in June 2014, thousands of civilians have been killed, and many more wounded. Millions of people have been displaced throughout the region, and it will take years to rebuild the affected areas. Alongside the humanitarian catastrophe, the ongoing fighting continues to leave a deep environmental footprint in its wake, a footprint that will hinder reconstruction efforts, and have long-term health and economic consequences for communities. This report has identified five key areas of concern:

Pollution from attacks on oil infrastructure

Damage to oil refineries, wellheads, pipelines and other oil infrastructure has created localised hotspots of pollution. People are likely to have faced acute and chronic exposures to a range of toxic compounds, heavy metals and particulate matter, which may have serious implications for their health. Ground and surface waters have been contaminated with oil products from soot and oil spills, affecting the supply of drinking and agricultural water. Cultivated and grazing lands have also been contaminated, with serious implications for agriculture and livelihoods. Assessing, remediating and monitoring the health, environmental and economic consequences of these attacks will place a huge technical and financial burden on the Iraqi state.

Increase of artisanal oil refining

ISIS's lack of access to professional oil infrastructure, and the demand for oil products in contested areas, has resulted in an increase in backyard refining in northern Iraq. Research by PAX and our partners has identified 20 clusters, containing more than 1,600 artisanal oil refineries, mostly in Ninewa and Kirkuk Governorates. Civilians that work, or have worked at these sites in the last two years will have been exposed to toxic chemicals, and the sites have left environmental contamination from the toxic waste products generated by the burning of crude oil.

Widespread damage to urban areas

The intense fighting that took place in populated areas resulted in severe damage to residential and industrial areas. Cities like Mosul, Ramadi, Tikrit and Fallujah witnessed high levels of destruction, resulting in millions of tonnes of rubble and debris, often comingled with household, medical or industrial wastes. The clean-up, transport, processing and safe storage

of this debris must be undertaken in a sustainable way that minimises the health risks to workers and communities, and limits its environmental footprint.

Damage to agricultural areas

Remote sensing and reporting from the ground have identified that the pattern of pre-conflict environmental degradation of agricultural lands, caused in part by poor water management and climate change, was amplified by the conflict in regions in northern Iraq. Areas where fighting took place saw low levels of agricultural production, with lands affected by pollution, rendered inaccessible by the fighting, or abandoned as farmers fled. Yet in other regions, mainly north of Mosul, agriculture flourished where it was supported by ISIS to generate income. Supporting agricultural and rural livelihoods in these areas may be important for Iraq's political stability.

Community concerns

The voices of communities affected by toxic remnants of war are a crucial component in post-conflict environmental assessment and recovery activities. Through its local partners, PAX submitted questions to focus groups in Qayyarah. The outcome highlighted the serious health concerns local people have as a result of being exposed for months to the noxious fumes from the burning oil wells. The groups all expressed the need for medical support and health monitoring, called for the swift assessment and remediation of contaminated areas, and highlighted the importance of health risk education for people living in these areas. ♦



Children in Makhmour, west of Mishraq, wearing protection masks to limit sulphur dioxide inhalation. October 23, 2016.

8. Recommendations

Iraq's recent conflict is proof of the increasing threats to people and ecosystems caused by the environmental dimensions of armed conflicts, and in particular the toxic remnants of war. Increasing industrialisation, and the trend towards conflicts in urban areas are increasing the likelihood of environmental health risks, and preventing and minimising these risks from armed conflicts warrants more attention from the international community. Based on the findings of this report, as well as PAX's wider work on conflict and environment, we make the following recommendations to States, international organisations and civil society:

For Iraq

- ♦ States should support the work of the Iraqi government, UN Environment and relevant civil society organisations to conduct a comprehensive post-conflict environmental assessment, and should provide the assistance and capacity necessary to undertake the field assessment and remediation of environmental hotspots.
- ♦ The Iraqi government should dedicate financial resources and expertise from relevant ministries to support remediation, health care and risk education in affected areas, and initiate monitoring of the environment and public health around contaminated sites
- ♦ The Iraqi government must ensure that the perspectives and concerns of affected communities are reflected in its post-conflict reconstruction plans and environmental assessments; PAX will continue to highlight the role that Iraqi civil society should play in developing conflict-sensitive environmental recovery policies and in providing oversight on the spending of reconstruction funds.

On the wider debate around the protection of the environment in relation to armed conflicts

- ♦ States should support the work of UN Environment and its Environment Assembly on the protection of the environment in relation to armed conflicts. This must include ensuring the effective implementation of relevant resolutions that contribute towards increasing the protection of civilians and their environment.

- ◆ States should contribute to and support work towards the progressive development of the legal framework protecting the environment in relation to armed conflicts, which is currently being undertaken by the International Law Commission.
- ◆ States should review and address current military practices that contribute towards the creation of environmental health risks in their operations, this should include reviews on weapon and munition developments and targeting policies; and should also provide greater transparency over targeting procedures and strikes.
- ◆ Humanitarian organisations should increase data collection and sharing on environmental hazards in their response work in order to help minimise the health risks faced by communities affected by the toxic remnants of war. ◆



Smoke from Alas oil wells set on fire by ISIS darken the sky, while the Iraqi army advances to liberate Hawijah. October 1, 2017.

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