# The Implications of the Reverberating Effects of Explosive Weapons Use in Populated Areas for Implementing the Sustainable Development Goals

**Christina Wille**

## Acknowledgement

## About the Author

Christina Wille is the Director of Insecurity Insight, an association of experts dedicated to improving data on people on danger. Together with Larissa Fast, she has set up the Security in Numbers Database on events that interfere with the delivery of aid. Christina Wille worked as senior research for the Small Arms Survey between 2003 and 2007. As consultant, she has set up the monitoring system on attacks on healthcare (2008- 2011) for the International Committee of the Red Cross (ICRC) and was co-author of the study that launched the ICRC's campaign on safeguarding healthcare. She has carried out numerous impact evaluations on small arms programmes in Africa for the European Commission and bilateral donors. She was educated in Cambridge and Durham, UK.

## About UNIDIR

The United Nations Institute for Disarmament Research (UNIDIR)—an autonomous institute within the United Nations—conducts research on disarmament and security. UNIDIR is based in Geneva, Switzerland, the centre for bilateral and multilateral disarmament and non-proliferation negotiations, and home of the Conference on Disarmament. The Institute explores current issues pertaining to the variety of existing and future armaments, as well as global diplomacy and local tensions and conflicts. Working with researchers, diplomats, government officials, NGOs and other institutions since 1980, UNIDIR acts as a bridge between the research community and governments. UNIDIR's activities are funded by contributions from governments and donor foundations.

## Note

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The views expressed in this publication are the sole responsibility of UNIDIR. They do not necessarily reflect the views or opinions of the United Nations or UNIDIR's sponsors.

www.unidir.org

# The Implications of the Reverberating Effects
# of Explosive Weapons Use
# in Populated Areas for Implementing
# the Sustainable Development Goals[*]

*'Sustainable development cannot be realized without peace and security; and peace and security will be at risk without sustainable development.'*

This statement in the Declaration of the 2030 Agenda for Sustainable Development emphasizes how the development and security agendas are inextricably linked.[1] Recognition of this point has led to the inclusion of Goal 16 of the Sustainable Development Goals (SDGs), which is dedicated to the promotion of peaceful and inclusive societies for sustainable development.

The increasing use of explosive weapons in populated areas threatens the achievement of Goal 16 and several other SDGs by hindering their implementation. Explosive weapons affect a wide range of SDGs, among them Goal 2, on ending hunger, Goal 3 concerned with health, Goal 4 on safe education, Goal 5 on women's empowerment, Goal 6 on water and sanitation, Goal 8 on employment, Goal 10, which focuses on inequality within and between countries, and Goal 11 on safer cities.

Concern has been growing in recent years about the use of explosive weapons in populated areas, particularly in conflicts in the Middle East and Ukraine. Explosive weapons vary considerably, and include artillery shells, missile and rocket warheads, mortars, aircraft bombs, grenades and improvised explosive devices. They can be air-delivered, or ground service ordnance or improvised explosive devices. They generally consist of a casing with a high-explosive filling.[2] Their common feature, however, is that they are indiscriminate within their zones of blast and fragmentation effect, which makes their use in populated areas highly problematic.[3] There is evidence that they are increasingly used in armed conflict.[4] The United Nations Secretary-General has repeatedly voiced his concern over the impact of explosive weapons on civilians.[5] The number of recorded casualties from the use of explosive weapons in populated areas has risen steadily over the years. In 2011, Action on Armed Violence (AOAV) recorded 21,000 deaths and injuries among civilians from explosive weapons. By 2014 this figure had risen to 32,000.[6] Yet, despite their devastating impact, the specific way in which explosive weapons affect development is not explicitly acknowledged in the 2030 Agenda for Sustainable Development.

---

Explosive weapons have devastating consequences for people's lives and development that are felt long after the blast occurs. In addition to killing and maiming people, explosive weapons can also destroy vital infrastructure and affect the delivery of services. Damage to housing, places of work, utilities and health facilities can result in people losing shelter and livelihoods, forcing them to live without water or electricity, and can create difficulties in accessing health and education services. Explosive weapons use can also affect people's access to food and the environment. They have a damaging effect on social capital, and affect gender relations. These knock-on and reinforcing effects and interactions are referred to in this paper as the ***reverberating effects of explosive force (REEF).*** The evidence presented suggests that these effects are causing damage on such a scale that they are undermining global efforts to achieve the United Nations post-2015 Sustainable Development Goals. This occurs in five ways:

- **direct casualties** from explosive weapons and **indirect casualties** from the reverberating effects of the destruction caused by explosive weapons in populated areas are contrary to the vision of a world free of fear and violence.
- the direct and reverberating effects of explosive weapons use in populated areas **have a negative impact on the enjoyment of a number of human rights** and are therefore contrary to the SDG vision of a world based on universal respect for human rights.
- fear of explosive weapons **discourages investors, private sector suppliers, and the operations of humanitarian agencies** because they fear losing staff and assets. This marginalizes affected communities who see their access to goods and services dwindle as trade and services decline. This breaks the sustainable development pledge that no one will be left behind.
- Destruction of industry and interruption of utilities reduces productivity and employment thereby **destroying livelihoods**. This runs counter to the SDG agenda's aim to build strong economic foundations for sustained, inclusive and sustainable economic growth.
- **destruction of key infrastructure** by explosive weapons requires substantial reconstruction. This absorbs scarce development resources that could have been invested elsewhere.

Drawing attention to wide ranging impacts of explosive weapons, this publication highlights the specific ways in which explosive weapons affect five central SDG goals and nine targets. The goals covered in this study are, in order: ***Ending Hunger*** (Goal 2), ***Ensuring Water and Sanitation*** (Goal 6), ***Health and Populations*** (Goal 3), ***Making Cities, Safe, Resilient and Sustainable*** (Goal 11), and ***Empowering Women and Girls*** (Goal 5). Progress towards these goals is held back by the lack of recognition and efforts to address the impacts of explosive weapons. These goals have been chosen as examples to start a debate. There are other important goals equally affected by the use of explosive weapons that could not be included in this primer.

By drawing attention to the effects of explosive weapons on these SDGs, this publication aims to extend the critical discussion of explosive weapons use in populated areas beyond disarmament circles to include development agencies and practitioners. It also aims to strengthen the gradually increasing recognition that explosive weapons use in populated areas is a humanitarian and development problem,[7] and to provide evidence in support of international efforts to build political commitment around the establishment of new standards of practice regulating the use of explosive weapons.[8]

**UNIDIR's approach to explosive weapons and engagement with the SDGs**

This study has been produced as part of UNIDIR's engagement with the SDGs[9] and is part of the implementation of the outcome of the United Nations Sustainable Development Summit of September 2015.

It builds on two previous UNIDIR projects concerned with explosive weapons. The Discourse on Explosive Weapons (DEW) project (2010–2011) helped to introduce the problem of explosive weapons use in populated areas into the thinking of multilateral practitioners and humanitarian actors such as United Nations agencies, with a view to enhancing the protection of civilians. The Norms on Explosive Weapons (NEW) project (2011–2012) examined normative aspects of explosive weapons use and management. In particular, the NEW project helped to clarify the conditions under which States consider the use of explosive weapons in populated areas to be acceptable.

**The analytical framework**

Analyses of the effects of explosive weapons distinguish between primary, secondary and tertiary effects. For the purposes of this study on the wider reverberating effects of explosive violence:

- The **primary effects of explosive weapons** are the direct impact of the weapons' components. They are caused by the high-pressure blast wave caused by the detonation, and fragmentation from the warhead. Measures of primary effects include detonation velocity, pressure, temperature and the velocity of fragments. In humans, primary effects cause injuries such as bursting of hollow organs (ears, lungs and the gastro-intestinal tract), brain damage, when the brain crushes into the side of skull, burns and projectile wounds from weapon fragments.
- The **secondary effects of explosive weapons** result from the interaction of the blast wave and fragmentation with the surrounding environment. In open spaces, the blast wave, which pushes outwards at supersonic speed from the core of detonation, often causes surrounding material (such as earth or rocks) to become secondary fragmentation. In air, the blast wave decays quickly with time and distance. In built-up areas, however, the blast wave is partially absorbed, reflected, refracted and channelled into structures. This causes a variety of secondary effects including structural collapse, shattered windows and fire damage. Secondary effects cause multiple human casualties through injuries from flying glass, crushing, suffocation and burns. Because of their diversity, secondary effects are difficult to measure accurately, and are often simply described in terms of the type and extent of damage caused.
- The **tertiary effects of explosive weapons** are the long-term impacts of the damage caused by explosive weapons on human living conditions. Tertiary effects are caused by damage or destruction to vital infrastructure, such as housing, utilities, or health facilities. Tertiary effects include a wide range of consequences of reduced access to services and infrastructure that are vital to sustain lives and livelihoods. Tertiary effects are measured in terms of changes in access to services, using standard indicators used in the health and water sectors. The duration of tertiary effects depends on the time it takes to repair damage and resume services, which in turn depends on the extent of destruction to local infrastructure and economic activities, as well as the resilience of affected communities. Systems that have been well managed and resourced prior to damage will usually recover more quickly than those that had been neglected before the event.

The concept of **reverberating effects of explosive force** (REEF) used in this paper covers the tertiary effects described above. It includes impacts on food security, water, sanitation, health care, and shelter. It covers the environmental damage caused by the destruction of infrastructure, and the displacement that results from the destruction. The concept also extends beyond the impact measurable in standard indicators and includes the impacts of explosive weapons on human behaviour, interaction, social capital and community resilience. Despite their importance, these effects have not been systematically examined in this context.

## The use of explosive weapons in populated areas in armed conflict

Explosive weapons cover a wide variety of ordnance categories including aerial bombs, mortars, artillery,[10] rockets, missiles, landmines and improvised explosive devices (IEDs). They can be stationary (e.g. a landmine or roadside bomb), remotely delivered (e.g. fired or dropped), or (in the case of IEDs) delivered directly through suicide attacks. Weapons that fail to function at the time of deployment are referred to unexploded ordnance. Munitions that have been left unused on the battlefield, or in stockpiles, are referred to as abandoned explosive ordnance. In humanitarian and political discourse, both are referred to as explosive remnants of war (ERW)[11] and as such can pose a long-lasting danger. The effects of explosive weapons, including their reverberating effects, will vary depending on the weapon type and yield, among other factors. This report mentions the broad category of explosive weapon used wherever possible, but it goes beyond the remits of the study to try to attribute specific reverberating effects in populated areas to identified categories of explosive weapons.

Both State forces and non-State actors use explosive weapons. However, most explosive weapons delivered from the air are dropped by State forces. Non-State armed groups use many types of ground-delivered explosives (such as grenades, mortars and rockets). IED use is usually, but not exclusively, attributable to non-State armed groups. Landmines are often used by both State and non-State actors.

The choice of explosive weapons used and the situation and environment in which these are detonated are always the result of human decisions, even in situations in which the effects were not necessarily intended. It is prohibited to directly target civilians and civilian objects under international humanitarian law (IHL). In an armed conflict, certain types of public infrastructure, such as transport and communication infrastructure, including bridges, railway lines and telephone infrastructure or broadcasting stations, are at particular risk of attack because they are generally acknowledged to be of military importance.[12]

'Terrorist' groups frequently intend to cause maximum harm, and often issue statements claiming responsibility. Most other users of explosive weapons usually deny the intention to harm civilians and rarely publicly report their intentions. In the majority of instances, intention can only be inferred from a broader context based on a detailed analysis of specific cases. There is mounting evidence that in some cases explosive weapons are deliberately used to target civilian infrastructure in populated areas where reverberating effects can be expected, such as hospitals, ports or water supply systems, (see Box 1). In June 2015, the United Nations Secretary-General reported that "Many parties in today's armed conflicts consistently show complete disregard for their obligations under international humanitarian law and contempt for human life. Deliberately targeting and brutalizing civilians and attacking vital civilian infrastructure have become routine objectives of parties to conflict".[13] However, the Secretary-General's report did not discuss the intentions of users of explosive weapons This UNIDIR study does not discuss IHL compliance but highlights the consequences of explosive weapons use in populated areas whatever the intention.

Even when parties to a conflict are seeking to uphold rules, the effects of explosive weapons use on civilians are often severe. Overall, there is little specific guidance for users of explosive weapons on how to use them in populated areas in order to prevent this civilian harm. This document describes the observed chains of events triggered by explosive weapons use in populated areas and its reverberating effects and consequences for a development outcome.

The reverberating effects of explosive weapons may be magnified or diminished depending on **pre-existing conditions** in the conflict area. For example, general water shortages in the Syrian Arab Republic and Yemen have made both countries especially vulnerable to explosive damage to water infrastructure and to transport disruption because of their dependence on imported food. The reverberating effects of explosive weapons are highly influenced by the quality of available services before the use of explosive weapons. Years of prior neglect and lack of investment and maintenance make it more difficult to restore water and health services after explosive damage. Examples of these **compounding factors** that make the reverberating effects of explosive weapons more or less severe are not the main focus of this report, but further examples will be provided in the thematic chapters.

*Box 1: Incidents in which explosive weapons appear to have been deliberately targeted at civilians or civilian infrastructure*

*Food blockades*

In the Syrian Arab Republic, for example, explosive weapons have been used to impose and maintain blockades of towns to deliberately cut off food supplies. This happened in Fuah and Kafraya, in Idlib Governorate, north-western Syrian Arab Republic,[14] where the town was surrounded and shelled, and in the town of Madaya, north-west of Damascus, where landmines were used to cut the town off. The blockades had disastrous humanitarian consequences,[15] reportedly leading to deaths from starvation. Aid convoys succeeded in negotiating access to enter these towns in early January 2016,[16] but hunger returned in February when the aid supplies ran out.[17] A siege limiting access to food has also been reported from Taiz in Yemen.[18]

*Access to water*

Explosive weapons have been used to directly target water supplies and sanitation infrastructure, according to the International Committee of the Red Cross (ICRC).[19] These attacks are part of a broader conflict over water in the Middle East where water is scarce and where warring parties have also used access to water as a strategy. For example, the non-State armed group "Islamic State" has diverted water from Lake Assad to Iraq and Aleppo partly to bring water to the areas under its control and partly to threaten downstream opponents.[20] Other rebel groups in Aleppo attempted to cut off water to the Government-held parts of the town in May 2014, but ended up depriving areas under their own control of water in the process.[21]

*Destruction of health facilities*

An uncounted number of hospitals in Afghanistan, Sudan, the Syrian Arab Republic, and Yemen have been hit and partially or completely destroyed by aerial bombardments that hospital operators claim can only be targeted attacks. Hospital operators said that that they regularly informed warring parties of the precise location of these hospitals, and that this excluded the possibility that they were targeted by mistake. In Kunduz, Afghanistan, for example, on 3

October 2015 airstrikes continued for 30 minutes after the hospital management had contacted officials informing them that they were under attack.[22] In Yemen, the roof of the hospital building in rebel-held Haydan District, Saada Province, northern Yemen, was clearly marked with its painted name and logo when it was hit on 26 October by air strikes.[23] This suggests that these were not incidents of collateral damage, but may been part of a strategy of deliberate targeting. In November 2015, the ICRC stated its belief that hospitals had been 'deliberately' targeted throughout Yemen.[24] On 15 February 2016, four hospitals were hit in the Syrian Arab Republic by what has been described as targeted attacks to drive the population out of the area.[25]

### *Destruction of housing*

Across the Middle East and Ukraine, housing has been destroyed in many places through the use of explosive weapons in populated areas. Some observers believe that some of this destruction is part of a deliberate strategy to displace more people, partly with the intention of destabilizing the countries where the displaced seek shelter through their rising numbers, and partly to create a vacuum for certain parties to the conflict to move into.[26]

### *Destruction of cultural heritage and identity*

Often driven by ideology, non-State actors have used explosive weapons to destroy ancient cultural monuments. For example, 'Islamic State of Iraq and the Levant' reportedly blew up numerous mosques, Islamic shrines and churches in Iraq, the Syrian Arab Republic and Libya, among them Jonah's tomb,[27] the Virgin Mary Church in Mosul,[28] and buildings at the ancient site of Palmyra, such as the temples of Baal and Bel,[29,30] parts of the ancient wall of Niniveh in Iraq[31] and many other structures.[32] The Taliban in Afghanistan used dynamite to blow up the Buddhas of Bamiyan in 2001.[33]

## Report structure and methodology

At the heart of this report are five chapters discussing the damage caused by explosive weapons on infrastructure and their reverberating effects of civilians' lives and well-being for five selected areas of the SDGs. The first three chapters examine the specific impacts of explosive weapons on food security, water and sanitation, and health, and identify the ways in which the reverberating effects disrupt specific points in the supply chains for these goods and services. The chapter on safe and resilient cities lists key aspects of functioning cities affected by explosive weapons use. The examples in the chapters have been selected to highlight the direct and indirect effects of explosive weapons, including little discussed impacts on community resilience and social capital, as well as broader implications for private investment and aid delivery. The final chapter suggests factors of how explosive weapons make women vulnerable and discusses possible consequences for women's empowerment. The conclusion summarizes the impact of explosive weapons on the SDGs and comments on consequences for the observed nature of the reverberating effects for policy responses.

The examples cited in this report have all been derived from English media reports that have been judged to be well documented and reliable. This is the best available source to start mapping the nature of a problem in a qualitative sense. However, this approach favours descriptions from locations better covered by English language media and risks ignoring other contexts. It is also not possible to verify fully the accuracy of claims made in the media reports. Moreover, the absence of systematic monitoring or data collection makes it impossible to quantify the scale of the problem.

In addition, the examples cited have been chosen because they illustrate a specific consequence of infrastructure destruction. Many examples are from the Syrian Arab Republic and Yemen and to a lesser extent from Iraq, Libya, Gaza, Afghanistan, South Sudan, Ukraine, the United Kingdom, Spain and the Russian Federation. Where relevant, the report also refers to historical data from the First and Second World Wars about long-term consequences. Overall, the geographical coverage of this report adheres to the new global approach of the SDGs, and is not limited in its focus to the global South.

A functioning food production-marketing-consumption chain is necessary for food security. Explosive weapons interrupt this chain at important points thereby reducing access to food and often causing substantial food price increases. To avoid hunger, people need to be able to produce food or they need markets to function (most people purchase some or all their food), and in cases of desperate need they require access to humanitarian relief.

No previous reports discussing the specific effects of explosive weapons on the food supply chain could be identified. This document draws on incident descriptions reported by the media to highlight the reverberating effects of explosive weapons on food supplies.

## The effects of damage to food production, transport and distribution facilities

Explosive weapons damage affects production, transport and distribution infrastructure to a much larger extent than other conventional weapon types.

Air-delivered explosive weapons have damaged industrial **food production** sites**.** For example, in November 2015, a bakery was hit by air-delivered explosives in Saraqib[34] and a chicken farm in Raqqa, both in the Syrian Arab Republic.[35] If ERW are scattered over cultivable land, crop cultivation is reduced. For example, in the Lao People's Democratic Republic a third of all land is still contaminated with ERW from the war years (1964 to 1973), affecting farmers the most.[36] Agricultural land can also be affected through the destruction of water supply, as happened for example in November 2015 in Deir ez Zor, Syrian Arab Republic, when air-delivered explosives destroyed a water pumping station responsible for providing water for 50,000 acres of land.[37] Damage to specialized production facilities can have a severe impact. For example, according to the charity which ran the bakery in Saraqib, Syrian Arab Republic, the factory supplied bread to around 45,000 internally displaced people daily before it was bombed.

Air-delivered explosive weapons have caused damage to important **transport hubs.** Depending on the strategic importance of these hubs, this destruction can have a devastating impact on food security. For example, when the port of Hodeida, Yemen, was hit by air strikes in August 2015, cranes and warehouses were destroyed and the port was closed.[38] Six weeks later, the Maritime Security Company, Mast, reported that one crane was working but that a fuel shortage made it likely that the port would be closed again.[39] As Hodeida is Yemen's most important entry point for imports, handling over half of all unloaded dry bulk cargo,[40] this damage had a devastating impact on food security in the country. The United Nations reported a 28 per cent rise in food prices across Yemen between August and September 2015.[41]

**Damage to local markets** can be caused by a much wider variety of explosive weapons. Some incidents have involved air-delivered weapons, such as the bombing of the livestock market in Fayyoush district, Lahj Province, Yemen, in July 2015.[42] Markets have also been damaged by ground-delivered weaponry, as occurred in mid-2015 in Donetsk, Ukraine,[43] or by IEDs and suicide bombings, such as the destruction of Yola market in Nigeria in November 2015.[44] Use of explosive weapons in the vicinity of markets tends to cause high numbers of casualties (45 dead, 50 injured in Fayyoush, Yemen, 32 dead, dozens injured in Yola, Nigeria). Such attacks also destroy food stocks and disrupt trade. However, these incidents rarely cause permanent closure of markets, which are of such importance to small-scale traders that many will continue to trade—despite the risks of repeat attacks.

## The reverberating effects of explosive weapons on the food supply chain

A functioning food supply chain depends on rational choices made by numerous suppliers of foods and related services. The risk of damage and destruction causes many suppliers to divert food stocks to areas not affected by explosive weapons and transport providers to alter their practices. For example, when the conflict in Yemen escalated in March 2015, 25 per cent of Saudi transport companies reportedly declined to transport goods into Yemen citing security concerns for their assets and staff. Commercial food importers in Yemen reported difficulties in using open letters of credit from banks for shipments into the country, which reduced the amount of food they were able to import.[45] Many insurance companies do not provide coverage for goods exported into areas of explosive weapon use. As one representative explained: 'It is like the analogy that you can't insure your house when it is already on fire.'[46] When aerial bombardment of Yemen began in March 2015, insurance companies focused on supporting the evacuation of assets instead of facilitating trade. These changes in commercial practices reduced the amount of accessible food.

Humanitarian agencies try to fill the gap left by market failures by providing food aid. However, they need to balance providing humanitarian aid with appropriate measures to protect their staff. The result is that their security risk assessments in the light of widespread aerial bombardments also tend to reduce their ability to deliver food. For example, humanitarian aid agencies relying on transport routes through north-western Syrian Arab Republic introduced precautionary security measures to lower the risk of their supply trucks being targeted when the number and frequency of air strikes in the area increased at the end of November 2015.[47] The cumulative impact of these measures—such as not permitting travel in convoys and changing offloading practices—reduced the quantity of all food delivery by 80 per cent, according to one humanitarian actor (Mercy Corps).[48]

**In summary,** the reverberating effects of explosive weapons indirectly increase mortality when the destruction they cause disrupts trade in food. Many people are made more vulnerable to malnutrition and disease. Infrastructure reconstruction destroys livelihoods and adds to the post-conflict development bill. Destruction by explosive weapons leads to marginalization of affected areas in world trade in goods and services.

Water supply is achieved through a functioning system of water collection, processing and distribution. Sanitation requires preventing human contact with hazardous waste by ensuring proper disposal of sewage and wastewater. Explosive weapons interrupt the water supply chain at important points thereby reducing the quantity and quality of available water. When explosive weapons destroy the waste disposal system, there may be devastating consequences on human health. Functioning water supply and sanitation systems need adequate and well managed water resources, functioning processing plants to ensure water quality, and efficient water distribution systems to deliver good quality water and avoid loss through leakage. Water supply and sanitation systems require good management and maintenance. In many countries, water supply is organized as a public service. In others, private companies provide the service under government regulation. If piped water supply is interrupted, bottled water has to be trucked in, either by commercial suppliers or humanitarian organizations.[49]

The ICRC has recently documented the connection between water, conflict and explosive weapons.[50] The Strategic Foresight Group published a detailed report on water and violence in the Middle East in 2014.[51]

## Damage from explosive weapons to water collection, processing and distribution systems

The use of high-intensity, explosive weaponry has repeatedly damaged water and sanitation systems in several countries of the Middle East in recent years. There are no reports that other weapon types have ever caused a comparable level of damage. Damage to water infrastructure has occurred at water pumping stations, water treatment facilities, and at points in the pipe distribution system. Electricity blackouts caused by explosive weapons-related damage can also interrupt water supply by bringing the pumping system to a halt. Explosive weapons use may also cause destruction that leads to water resources becoming contaminated (see Goal 11). During the Second World War, British bombers targeted German dams,[52] but there are no recent reports of

dam infrastructure being bombed. Instead, armies have sought to control the area around dams to control water supplies downstream.[53]

Damage to **water pumping stations and wastewater treatment facilities** can often affect large populations. For example, damage to the water pumping station in Deir ez Zor (in November 2015) reportedly deprived 100,000 people of water,[54] whereas the combined impact of the damage to wastewater treatment plants around Aleppo and Damascus, in the Syrian Arab Republic, is estimated to have affected 3.4 million people in 2015, according to ICRC figures.[55]

The impact of damage to **pipe distribution systems** depends on where the damage occurred in the distribution network. Damage to a central distribution line can affect a large area. The damage to the water pipelines from Orontes to Hama and Homs, Syrian Arab Republic, in 2014 cut off water to both cities for weeks, affecting around 1.5 million people.[56] According to Oxfam, the first seven weeks of airstrikes in Yemen damaged 40 per cent of the clean water supply system in Jajjah and Al Hodeidah governorates, and thereby deprived an estimated 3 million people of clean water.[57] Damage to branch-line pipes can also affect very large numbers of people. In Aleppo, the 2014 bombing of the water pipeline affected three of the four major pipes[58] and thereby affected some 2 million of the city's 2.3 million inhabitants.[59] In Baghdad in 2003, around 40 per cent of the water network was destroyed through bombing and half of the city, some 1.9 million people, lost access to a running water supply.[60]

Interrupted water supplies cause an increase in the cost of living owing to the price of bottled water, loss of economic productivity through the additional time spent securing water, and forced adaptation of hygiene practices. This puts vulnerable people at greater risk of infectious diseases. In Aleppo, kidney infections, typhoid and salmonella were reported.[61] Untreated sewage may contaminate groundwater.[62] Additional well digging to tap into new supplies may lower groundwater levels.


## The reverberating effects of explosive weapons on water supply systems

In the Middle East, water and sanitation systems have for years been under strain from lack of rain, growing population, over-extraction and mismanagement.[63] The investment required to upgrade water systems fails to materialize where investors fear that systems may be destroyed by explosive force.[64] In 2005, the Government of the United States earmarked funds for investment in Iraq's water systems, but security concerns halted the process.[65] A decade later, the United Nations Office for Coordination of Humanitarian Affairs reported that more than 7 million people still depend on bottled watered trucked in to populations as water supply systems remain unrepaired.[66]

Poor maintenance leads to water loss through leakages. In Damascus, Syrian Arab Republic, the water supply system loses up to 70 per cent of water through leakage.[67] Moreover, large-scale population movements across the Middle East of people seeking safety from the violence have put the ageing water systems of host communities under extreme strain.[68]

**In summary,** destruction of water supply systems can contribute to higher indirect mortality because the lack of clean water can lead to higher incidents of serious disease. Areas affected by explosive weapons use in populated areas remain marginalized from infrastructure investment. The capital intensive investment required to replace and repair adds greatly to the reconstruction bill.

**SDG Goal 3: Ensure healthy lives and promote well-being for all at all ages**

*Targets:*

**3.8:** Achieve (…) access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.

**3.12:** Substantially increase (…) recruitment, (…) and retention of the health workforce (…)

*Explosive weapons undermine safe access to health care by destroying health care infrastructure such as hospitals, clinics and health care transport, notably ambulances. Hospitals under attack frequently have to be evacuated, which puts vulnerable patients and staff at risk. The quality of health care may also be undermined by disruption to supply chains. Aid agencies providing health care services in conflict zones may be forced to close or limit operations where they suffer an attack or feel threatened by the use of explosive weapons. The death toll among staff and the difficult living conditions make it difficult to retain qualified medical staff, as many leave areas affected by explosive weapons.*

Access to health care requires the provision of safe health facilities, supply of medicines, electricity and clean water, medical transport and appropriate working and living conditions for health care workers. All of these requirements can be compromised by the use of, or threat of the use of, explosive weapons.

## The effects of explosive weapons on health care facilities and transport

The use of largely air-delivered explosive weapons has **damaged a large number of hospitals** in Afghanistan, Sudan, Syrian Arab Republic and Yemen. The non-governmental organization (NGO) Physicians for Human Rights counted 336 attacks on medical facilities in the Syrian Arab Republic between January 2012 and January 2016.[69] According to Medécins Sans Frontières (MSF), 130 health facilities were attacked in Yemen between March 2015 and January 2016.[70] No other weapon type has caused comparable damage to health infrastructure.

When a health facility comes under attack, it has to be **evacuated, which causes additional stress and danger for patients and staff**. For example, in July 2014, when the al-Wafa hospital in Gaza was shelled, nurses ran on to the road and flagged down ambulances while dodging fire in order to evacuate patients.[71] In Yemen, MSF staff evacuated patients between air strikes.[72] In South Sudan, staff at the MSF hospital in Leer fled into the bush, carrying patients on their backs.[73] In some cases, sudden attack makes evacuation impossible, as was the case during the aerial bombardment of the MSF hospital in Kunduz where patients burned to death in their beds.[74]

**Hospitals damaged by explosive weapons are often forced to reduce the range of services offered**. For example, Shiara Hospital in Razeh District, Yemen, had to reduce its services to stabilization, emergency, maternity and lifesaving activities due to damage from bombs in late 2015. In January 2016, a projectile hit the hospital and the building collapsed reducing the facilities to six inpatient beds for day time emergencies.[75]

**Damage to electricity supply can have terrible consequences for patients in hospitals** because most modern health care facilities are heavily dependent on access to stable power. For example, in 2012, it was reported from Homs in the Syrian Arab Republic that 18 premature babies died because their incubators failed during a power cut caused by shelling.[76] Loss of electricity can affect the safe and proper storage of drugs and blood supplies, putting the safety of patients at

risk. Most hospitals run backup generators, but fuel to operate them can be challenging to obtain in conflict environments.[77]

**Vehicles providing essential transport services for health facilities may also be damaged or destroyed by explosive weapons**. For example, in October 2015 aerial bombardment hit the ambulance centre in Idlib Governorate, Syrian Arab Republic, destroying four out of five ambulances.[78] Loss of ambulance services reduces access to health services and inevitably raises death rates.[79]

**Explosive weapons can also disrupt the supply of essential supplies** and thereby reduce the effectiveness of health services. Supply tends to be affected by damage and destruction of key transport hubs, or by the unwillingness of transporters to drive into areas affected by explosive weapons. For example, it was reported that the main paediatric hospital in the northern part of Yemen closed because of a combination of lack of drugs and fuel, and the physical damage caused by explosive weapons.[80]


## The reverberating effects of explosive weapons on the health system

IHL extends particular protection to medical facilities. However, as there have been an increasing number of attacks on health facilities caused by negligence or deliberate targeting, **humanitarian agencies are increasingly reluctant to work in conditions** in which their neutral and protected status is not respected. In fragile States, humanitarian health agencies often provide key health services. If they leave, many people are left without many health services. For example, MSF closed its hospital in Farandala, South Kordofan, after it was bombed for a second time in January 2015[81] leaving the population with only two hospitals (both run by charities) and one qualified surgeon serving 1 million people. Both of these hospitals have also been bombed (Lwere in May 2014 and Gidel in May 2015).[82]

Attacks on health facilities and the perception that they are deliberately targeted can make **patients afraid to use health services**. For example, the Shiara hospital in Yemen reported the absence of pregnant women in maternity services for fear of bombing.[83] When health infrastructure has been destroyed, people have to travel long distances for medical help. Reluctance to seek medical assistance or travelling far increases the risk of additional medical complications and may result in deaths that would have been preventable.

**Medical staff may find the working conditions and risks to their personal safety intolerable** in areas threatened by explosive weapon use. Many trained medical professionals want to work in their profession unhindered and decide to leave in order to work where this is possible. According to ICRC figures, 20,000 of the 34,000 doctors registered in Iraq in 1990 had left the country by 2008.[84] The majority of these doctors cited security concerns as the main reason they left.[85]

**In summary,** people living in areas affected by explosive weapons use suffer elevated mortality as a result of reduced access to health care due to damage to infrastructure and health care providers being unable to safely provide services. This contributes to elevated mortality.

> **SDG Goal 11: Resilient infrastructure for safe, inclusive and sustainable settlements**
>
> *Targets:*
>
> **11.1:** By 2030, ensure access for all to adequate, safe and affordable housing (…)
>
> **11.4:** Strengthen efforts to protect and safeguard the world's cultural and natural heritage

> *Widespread destruction of residential buildings by explosive weapons has deprived many people of safe, adequate and affordable housing. Explosive weapons can damage transport systems, historical sites, and the environment. Damage or destruction of electricity plants has far-reaching effects on living standards and causes many downstream effects on access to food, water and health care, as well as damage to the environment. The use of explosive weapons in urban areas is also a major driver in forced displacement.*

The goal of providing safe, inclusive and sustainable settlements requires a clean environment, good quality housing, and access to electricity and water. Sustainable settlements need a good transport system and access to key services for health and culture. Cultural sites enhance the value of cities. Functioning cities prevent large-scale migration.

There has been no comprehensive study on how explosive weapons undermine these broad requirements of safe, inclusive and sustainable settlements. Effects on some sectors, such as the environment and cultural monuments, are well documented. Other impacts, such as explosive damage to transport systems and power plants, are not well studied.

### The effects of explosive weapons on settlements

**The use of explosive weapons in populated areas destroys housing**. Accurate data on the extent of housing destruction usually only becomes available sometime after the end of the conflict. In 2013, the United Nations estimated that one-third of the housing stock in the Syrian Arab Republic had been destroyed by the ongoing conflict.[86] During the 2014 hostilities in Gaza, 18,000 housing units were destroyed and 108,000 people were made homeless.[87] Historical data from the Second World War show that bombing raids on London damaged or destroyed approximately 1 million homes.[88] By 1945, around 40 per cent of all civilian housing in Germany and Japan was destroyed. Seven million Germans had lost their homes. One study of German re-development from 1945 demonstrated that it took several years for towns to reach their pre-war population levels. Moreover, substantial public investment for rebuilding was shown to be vital—as was underlined by contrasting rates of recovery between East and West German towns.[89]

**The effects of explosive weapons on transportation systems** are generally poorly documented. Terrorist attacks using IEDs on underground or rail structures have received much attention, such as the bombings in Madrid (2004), London (2005) and Moscow (2010). Although, these caused significant loss of life, disruption to the transport system was temporary. More long-lasting effects occur in countries with weaker institutions and resilience. The effects are most serious when transport hubs and crucial supply routes are damaged. Destruction of bridges with explosives can cut off populations from exit or supply routes.[90] For example, in Iraq in 2009 the destruction of a bridge outside Ramadi affected a major civilian traffic link between Iraq, the Syrian Arab Republic and Jordan, and a route that many Iraqis took to escape the violence. [91]

**Damage to electricity supply** can cause serious environmental effects, in addition to affecting water supply and health care. For example, in Donetsk, Ukraine, the ventilation system and water pumps in several coal mines failed when damage from explosive weapons above ground cut electricity. This resulted in flooding of some mines, which damaged installations, polluted the groundwater, and released toxic gases after ventilation restarted.[92]

Repairs are made difficult by **blockades** and damage to transport routes that prevent importation of replacement parts, and by dangers and difficulties in accessing damaged sites.

**Explosive Remnants of War (ERW) can render urban areas unsafe.** In the city of Kobani, Syrian Arab Republic, for example, the NGO Handicap International documented in April 2015 an average of ten visible pieces of munitions per square metre in the city centre following the use of explosive weapons in ground fighting and air strikes.[93] Remnants of explosive weapons can contaminate long after the fighting has ended. Unexploded ordnance from the Second World War is still being discovered during building work in European cities in 2016, 70 years after the war ended.[94]

**The use of explosive weapons can also have other environmental effects.** In some cases, the damage and disruption has led to accidental releases of pollutants from damaged facilities. In other cases, the rubble and dust from destroyed buildings can be hazardous.[95] Many environmental effects are the result of a chain of events set in motion by the reverberating effects of explosive weapons. For example, when the bridge in Kondrashevskaya-Novaya, Ukraine, was destroyed, coal supply to the power plant in Luanska was curtailed. When an electrical substation was shelled, the Luanska power plant was cut off from Ukraine's electricity grid. As the power plant was vital to the area, production was increased with lower-grade coal from its reserve stock. This caused a deterioration in air quality.[96]

**Fighting with the use of explosive weapons has damaged many important historical sites.** In the Syrian Arab Republic, bombing and tank shelling damaged historical monuments in Aleppo and the archaeological site of Bosra.[97] In Yemen, air strikes hit the historic old city of Saada, damaging several centuries-old mosques[98] and the eighth century B.C. Marib Dam, considered a wonder of the ancient world.[99] The destruction of historical monuments destroys the connection to values and beliefs which allow people to identify with the town and previous generations, and undermines the heritage of all humankind.

## The reverberating effects of explosive weapons on the safety of settlements

The destruction of towns is one of the main driving forces of mass displacement, forcing people to leave their homes to avoid the effects of violence.[100] Conflict has displaced some 7 million people across the Middle East.[101] This directly impinges on the objectives of the SDGs, as becoming displaced often poses a series of additional challenges in achieving access to food, water, health care, and protection from the threat of sexual violence. As for those who stay, a survey of the living conditions of 1 million Syrians showed that at least 42 per cent lived in substandard or informal housing in 2015.[102]

**In summary,** the use of explosive weapons in urban areas destroys housing and the economic foundation. It increases the direct and the indirect casualty rate. Displacement in particular creates severe vulnerabilities. Rebuilding cities after widespread urban bombing is extremely costly, in particular when a large percentage of housing stock has to be rebuilt. Affected communities are often marginalized globally and within their country, and are rendered considerably more vulnerable to threats and abuse of various kinds.

> **SDG Goal 5: Achieve gender equality and empower all women and girls**
>
> *Targets:*
>
> **5.2:** Eliminate all forms of violence against all women and girls in public and private spheres (…)
>
> **5.5:** Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

> *Violence using explosive weapons kills and injures women and girls. Although there have been few contemporary studies on how explosive weapons affect women and their roles in economic and political life, the available evidence suggests that their use in populated areas may pose a greater risk to women than any other weapon category. The destruction of infrastructure and services by explosive weapons makes the practical tasks expected of women and girls in their daily lives more burdensome. In societies where domestic duties are primarily a woman's responsibility and social expectations mark females as caregivers, women and girls also have to ensure continuation of daily life when water and electricity are interrupted and food prices rise. They have to care for family members injured and permanently disabled by explosive weapons, often in the absence of health infrastructure. These longitudinal impacts hinder women's ability to participate in public life. Overall, much more research is needed to understand how explosive weapons affect women's empowerment.*

**The Women, Peace and Security agenda**, based on Security Council Resolution 1325,[103] **recognizes the precarious situation of women in conflict, but also calls upon all States to allow for increased participation of women in decision-making on matters of peace and security.**[104] Addressing women's needs in conflict requires protection from violence and its consequences, and space for women to participate in economic and political decision-making in the reconstruction of societies in the aftermath of war.

In 2014, the Reaching Critical Will Disarmament Programme of the Women's International League for Peace and Freedom (WILPF) produced the first overview of the impact of explosive weapons on women, which highlighted key aspects of how women are made vulnerable by explosive weapons.[105] The overview implies that much remains to be done in examining and drawing attention to reverberating impacts. No work related to contemporary conflicts could be identified that discussed the effects of explosive weapons use in populated areas on women's empowerment and gender equality. Some documented psychological impacts on caregivers of small arms victims are likely to also apply to women caring for family members injured by explosive weapons.

## The effects of explosive violence on women and girls

Qualitative accounts of the death toll from the use of explosive weapons in populated areas suggest that **women make up a sizeable proportion of the civilian causalities.** Many of the high-casualty incidents occur in places where women are often present, such as markets, homes and schools.[106] However, quantitative data on the casualties of explosive weapons are usually not disaggregated by gender. In 2014, AOAV recorded over 40,000 casualties from the use of explosive violence, of which 78 per cent were civilians, but the number of women among them was not reported.[107] Yet a study on casualties in Iraq indicated that women made up 34 per cent of civilian casualties from explosive weapons use. This is the highest proportion of female casualties of all weapon categories.[108] **These data suggest that women are highly vulnerable to death and injury**

from explosive weapons because they are likely to be in places such as residential buildings and markets that are often affected by explosive weapons use in populated areas.

### Effects on women's and girl's empowerment and participation in decision-making

There are no focused studies of the extensive use of explosive weapons in populated areas affects women's empowerment and participation in decision-making.

**In many societies, women are expected to carry out most, if not all, of the domestic labour, which reduces women's ability to participate in political and social life and decision-making.** The evidence discussed for other SDGs in previous chapters strongly suggests that the destruction caused by explosive weapons in populated areas will increase the time spent on domestic work because the performance of daily chores becomes more burdensome. The limited availability of food requires many hours spent queuing to access basics foods, as was reported from Donetsk, Ukraine,[109] and Yarmouk refugee camp in Damascus, Syrian Arab Republic, in February 2014.[110] Damage to piped water supply has an enormous cost in terms of the additional time spent obtaining water. Interruptions to electricity and water supplies force people to abandon labour saving technology and switch to basic techniques such as washing by hand.[111]

**Women and girls are also usually the main caregivers for family members.** Caring for children becomes more difficult when schools are closed because of damage or because they are used as shelters. In the Syrian Arab Republic for example, it was found that school attendance was down to approximately two days a week.[112] Caring for elderly family members is made more burdensome when access to food and water is reduced. Explosive violence leads to added caring responsibilities when family members are injured by explosive weapons and suffer the long-term effects of violently acquired disability. Caregiving has clear economic, health, and human rights implications for women. Many caregivers, particularly in low-income settings, suffer economically because they are not able to work outside the home or participate in education or training.[113] Caregiving can lead to vicarious trauma, the indirect or secondary traumatization experienced by caregivers.[114]

Destruction of infrastructure by explosive weapons and the consequential decline in services requires changes to daily routines. This reduces women's capacity to participate in political and social life, and thereby reinforces their disempowerment in the longer term.

**In summary**, the upheaval caused by the destruction from explosive weapons will affect gender relations in many nuanced ways. More research is needed to understand how explosive weapons make women and girls vulnerable, overburden them, and therefore affect their ability to participate fully in economic and political life.

## Conclusion

This document introduced five selected SDGs and highlighted the numerous ways in which the use of explosive weapons in populated areas impede progress towards their implementation. Although other SDGs are not examined here, this study's findings suggest that their implementation may also be affected by explosive weapons use.

The effects of explosive weapons in populated areas have been described as "reverberating" because they extend beyond the immediate loss of life to affect infrastructure, service delivery, economic activities, social capital and gender relations. Reverberating effects may be difficult to recognize because they result from the complex interaction of multiple detonations and pre-existing weaknesses in infrastructure and institutions. But they are no less real for that. Very often, the reverberating effects connect with and magnify each other. Destruction of transport hubs affects the delivery of food, medicines and reconstruction materials. Destruction of power plants affects the ability to supply piped water, run hospitals safely and keep bakeries going. All of these impacts affect productivity. The effects can be long-lasting, and can only be addressed by reconstruction efforts, which themselves consume scarce resources that could have been used for other development purposes. The use of explosive weapons greatly adds to investors' and insurers' perceptions of risk, which can effectively cut off capital flows to areas in great need of development. The combined factors lead to marginalization of affected regions within countries and global marginalization of societies affected by explosive weapons use in populated areas.

To summarize the numerous examples documented in this paper, five levels of effects of explosive weapons can be highlighted.

1. **Direct casualties from explosive weapons and indirect casualties from the reverberating effects of the destruction caused by explosive weapons in populated areas are contrary to the vision of a world free of fear and violence.**

Explosive weapons kill and injure through the primary effects of the blast wave and the secondary effects of collapsing structures. They also elevate mortality and damage health outcomes through the reverberating effects on food, water and power supply, and access to health care. Reduced trade in food, medical supplies and fuel all contribute to a rising indirect death toll.

2. **The direct and reverberating effects of explosive weapons use in populated areas have a negative impact on the enjoyment of a number of human rights and their use is therefore contrary to the SDG vision of a world based on universal respect for human rights.**

The post-2015 Sustainable Development Agenda is grounded in the Universal Declaration of Human Rights and international human rights treaties. Human rights considerations have been largely absent from the debate of how explosive weapons affect people. However, human rights law is nevertheless a relevant legal framework because human rights protection does not cease in times of armed conflict.[115] The use of an explosive weapon risks having a negative impact on the enjoyment of a wide range of human rights: the direct effects violate the right to life. The destruction of homes and displacement this causes can amount to a violation of the right to respect for private and family life and for one's home or the violation of the right to freedom of movement and residence if it forces people to leave their homes. In addition, the reverberating effects of explosive weapons use can also affect a host of economic, social and cultural rights, for example through the destruction of cultural monuments.

3. **Fear of explosive weapons discourages investors, private sector suppliers, and the operations of humanitarian agencies because they fear losing staff and assets. This marginalizes affected communities who see their access to goods and services dwindle as trade and services decline. This breaks the sustainable development pledge that no one will be left behind.**

The post-2015 Sustainable Development Agenda features partnership with the private sector as being vital to its large-scale strategy.[116] Private commercial investment and remittance flows have overtaken official development assistance to developing countries.[117] However, many companies are unwilling to invest, trade or deliver services in areas affected by explosive weapons as they fear loss of life among their staff and destruction of their capital. Humanitarian agencies seek to fill the gap left by a disappearing private sector, but often struggle to gain access to the most severely affected populations because they too have to balance staff risk with humanitarian goals. As a consequence, for millions of people the SDG preamble pledge that no one will be left behind has already been broken as a result of the use of explosive weapons.

4. **Destruction of industry and interruption of utilities reduces productivity and employment thereby destroying livelihoods. This runs counter to the aim of the Sustainable Development Agenda to build strong economic foundations for sustained, inclusive and sustainable economic growth.**

The SDGs envisage a world in which every country enjoys sustained, inclusive and sustainable economic growth and decent work for all. The destruction of industry and services and interruption of utilities is a severe obstacle to sustainable economic growth. Societies affected by explosive weapons use usually see a decline in measurable economic activity, thereby making the vision for inclusive opportunities and wealth creation unattainable.

5. **Destruction of key infrastructure by explosive weapons requires substantial reconstruction. This absorbs scarce development resources that could have been invested elsewhere.**

Damaged infrastructure has to be repaired for living conditions to be improved and development objectives to be reached. Enormous costs are incurred in the repair or rebuilding of housing, electricity and water plants, roads, power lines and port infrastructure. These costs stretch government and donor budgets and inevitably take resources away from other development initiatives.

The commitment to work tirelessly for the full implementation of the SDG agenda by 2030 requires that the use of explosive weapons in populated areas be addressed by the international community.

## Implications for existing norms and practical guidance on explosive weapons

The examples discussed in this report indicate that air-delivered ordnance and ground-delivered heavy artillery cause most of the damage to vital infrastructure. From a humanitarian and development perspective, these weapons with wide-area effects are the most critical category of explosive weapons in populated areas. Most heavy explosive weapons are used in the context of an armed conflict for the conduct of hostilities, and their use is therefore governed by the rules of

IHL. The principles underpinning IHL require military necessity to be balanced against regard for humanity. This balancing is embodied in a number of specific legal rules, such as those relating to avoidance of superfluous injury and unnecessary suffering by combatants, environmental protection, indiscriminate attacks, and feasible precautions in attacks.[118] The major burden in ensuring compliance with IHL falls on military commanders who have to assess anticipated levels of civilian harm and decide on a strategy balancing that against anticipated military advantages for each attack.[119]

The discussion of the reverberating effects in this document demonstrates the magnitude of downstream reverberating humanitarian and development consequences when civilian infrastructure is damaged or destroyed. These effects are a direct consequence of infrastructure destruction and, as such, can be anticipated if the full infrastructure and service provision landscape is considered. Therefore, they ought to be factored into the *ex ante* balancing assessment. However, at present there are insufficient practical guidelines to help commanders anticipate the cumulative reverberating effects of explosive weapons use in populated areas. To ensure protection of civilians from explosive weapons use, there would have to be a systematic assessment of civilian harm that also considers the damage already caused by previous attacks by any party to the conflict in the relation to the existing capacity to repair and restore damage and destruction. At present, many questions remain as to how military forces incorporate the risk of the reverberating effects into their policies and practices. IHL rules on the conduct of hostilities, as they are currently interpreted and applied, may not provide an adequate framework for effectively protecting civilians against direct and cumulative reverberating effects of explosive weapons use in populated areas.[120]

In recognition of this fact, the United Nations Secretary-General has called on "parties to conflict to refrain from using explosive weapons with a wide-area impact in densely populated areas".[121]

## Linking the problem of explosive weapons to the Sustainable Development Goals

The SDGs refer to the development impact of violence. But most of the effects described relate to the effects of small arms and light weapons: the specific effects of explosive weapons are not mentioned. This omission is regrettable because explosive weapons have been shown to have particularly destructive and far-reaching impacts on infrastructure and service delivery that threaten to undermine the achievement of the SDGs. Explosive weapons are similar to small arms insofar as use of each category of weapon kills and injures people, and carry indirect effects. Both categories of weapons enable non-State actors to undermine the authority of the State. Both create insecurity, which prevents investment, trade and service provision in affected areas. These are problems recognized by the SDGs.

In terms of humanitarian and development consequences, the most important difference between small arms and explosive weapons is the extent to which explosive weapons damage and destroy infrastructure and thereby affect a wide range of essential services. These wide-area effects make explosive weapons a serious—but under-recognized—threat to the achievement of the SDGs. Policy discussions have so far treated explosive weapons mainly from the perspective of security and preventing immediate loss of life. The evidence presented in this paper points to the need to bring development and public health perspectives into the discussion to give full recognition to the reverberating effects of explosive weapons and their damaging effects on the implementation of several of the SDGs.

# Endnotes

[1] United Nations, *Transforming our World: The 2030 Agenda for Sustainable Development,* 2015, https://sustainabledevelopment.un.org/post2015/transformingourworld, paragraph 35.

[2] John Borrie and Maya Brehm, "Enhancing Civilian Protection from Use of Explosive Weapons in Populated Areas: Building a Policy and Research Agenda", *International Review of the Red Cross*, vol. 93:883, September 2011, https://www.icrc.org/eng/assets/files/review/2011/irrc-883-borrie-brehm.pdf.

[3] Simon Bagshaw, "Driving Displacement: Explosive Weapons in Populated Areas'', *Forced Migration Review*, issue 41: Preventing Displacement, 2012, http://www.fmreview.org/preventing/bagshaw.html#sthash.Xo8gXAGm.dpuf.

[4] Christina Wille and Larissa Fast, *Humanitarian Staff Security in Armed Conflict. Policy Implications for the International Community from Changes in the Operating Environment for Humanitarian Agencies*, Insecurity Insight Fact Sheet, March 2013,
http://www.insecurityinsight.org/files/Policy_Brief_1_Humanitarian_Staff_and_Armed_Conflict.pdf

[5] Security Council, *Report of the Secretary-General on the protection of civilians in armed conflict*, UN document S/2015/453, 18 June 2015, http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2015_453.pdf

[6] Action on Armed Violence, *Explosive Weapons Harm. Civilians Killed and Injured Globally*, 2016, https://aoav.org.uk/

[7] The issue was recognized in the Secretary-General's report for the World Humanitarian Summit, for example (United Nations Secretary-General, *One Humanity: A Shared Responsibility*, 2016,
http://sgreport.worldhumanitariansummit.org).

[8] Sebastian Kurz (Austrian Foreign Minister), "It is Time to Stop the Indiscriminate Bombing and Shelling of Urban Areas", *The Guardian*, 22 December 2015, http://bit.ly/1ZoS1dB

[9] See: http://www.unidir.org/about/the-institute/development.

[10] For example, the Russian GRAD is classified as an artillery system (see: http://www.military-today.com/artillery/grad.htm).

[11] Paddy Blagden and Adrian Wilkinson, *Explosive Remnants of War (ERW): Definitions*, Geneva International Centre for Humanitarian Demining, 2001, http://www.gichd.org/fileadmin/GICHD-resources/rec-documents/UXO_Definitions_Paper.pdf.

[12] Maya Brehm, *Protecting Civilians from the Effects of Explosive Weapons. An Analysis of International Legal and Policy Standards*, UNIDIR, 2012, http://www.unidir.ch/files/publications/pdfs/protecting-civilians-from-the-effects-of-explosive-weapons-en-293.pdf, Footnote 307.

[13] *Report of the Secretary-General on the protection of civilians in armed conflict*, UN document S/2015/453,18 June2015, http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/s_2015_453.pdf, pp.10–11.

[14] Leith Fael, "Jaysh Al-Fateh Begins Ground Operations at Al-Fou'aa and Kafraya in Idlib", *Al Masdar News*, 24 July 2015, http://www.almasdarnews.com/article/jaysh-al-fateh-begins-ground-operations-at-al-fouaa-and-kafraya-in-idlib/.

[15] Kareem Shaheen, "Wounded Syrian Fighters and Civilians Evacuated under UN Deal", *The Guardian*, 29 December 2015, http://www.theguardian.com/world/2015/dec/29/syria-war-fighters-civilians-evacuated-un-deal; See map showing the blockade of Fuya and Kafraya in: "Battle Map Update of Kafraya and Al-Fou'aa: Jaysh Al-Fateh on the Offensive", *Almasdar News*, 7 September 2015, http://www.almasdarnews.com/article/battle-map-update-of-kafraya-and-al-fouaa-jaysh-al-fateh-on-the-offensive/.

[16] Kushbu Shah, Nick Paton Walsh and Peter Wilkinson, "Madaya: Syria Allows Aid to Reach City Facing Starvation, Says U.N." *CNN*, 8 January 2016, http://edition.cnn.com/2016/01/07/middleeast/syria-madaya-starvation; Laura Pitel, "War in Syria: Up to 40,000 Civilians Are Starving in Besieged Madaya, Say Campaigners", *The Independent,* 1 January 2016, http://www.independent.co.uk/news/world/middle-east/war-in-syria-up-to-40000-civilians-are-starving-in-besieged-madaya-say-campaigners-a6793386.html.

[17] Emma Graham-Harrison and Kareem Shaheen, "Madaya Again Facing Starvation as Report Warns of Extent of Sieges", *The Guardian*, 9 February 2016, http://www.theguardian.com/world/2016/feb/09/madaya-siege-starvation-syria-aleppo-united-nations.

[18] Ghaith Abdul Ahad, "Life under Siege: Inside Taiz, the Yemeni City Being Slowly Strangled", *The Guardian*, 28 December 2015, http://www.theguardian.com/world/2015/dec/28/life-under-siege-inside-taiz-yemen-houthi.

[19] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 5.

[20] Strategic Foresight Group, *Water and Violence: Crisis of Survival in the Middle East*, 2014, http://www.strategicforesight.com/publication_pdf/63948150123-web.pdf, p. 20.

[21] Patrick Cockburn, "Syrian Rebels Cut off Water to Aleppo in Botched Attack on Regime Areas – and Manage to Create Shortage in Their Own Strongholds", *The Independent*, 12 May 2014, http://www.independent.co.uk/news/world/middle-east/syrian-rebels-cut-off-water-to-aleppo-in-botched-attack-on-regime-areas-and-manage-to-create-9358685.html; Naline Malla and John Davison "Water a 'Weapon of War' in Syria's Divided Aleppo", *Reuters*, 15 October, 2015, http://uk.reuters.com/article/uk-mideast-crisis-syria-aleppo-idUKKCN0S91E220151015.

[22] Médicins Sans Frontières, *Kunduz Hospital Attack*, MSF Fact Sheet, 7 October 2015, http://www.msf.org/article/factsheet-kunduz-hospital-attack.

[23] "Yemen: Coalition airstrikes hit hospital", *Human Rights Watch*, 27 October 2015, https://www.hrw.org/news/2015/10/27/yemen-coalition-airstrikes-hit-hospital.

[24] "Yemen Hospitals 'Deliberately' Targeted in 100 Attacks Since March – ICRC", *RT*, 11 November 2015, https://www.rt.com/news/321522-yemen-hospitals-deliberately-targeted/.

[25] Anne Barnard, "Syrian Hospitals Hit as Battlefield Grows More Chaotic", *The New York Times*, 15 February 2016, http://www.nytimes.com/2016/02/16/world/middleeast/syria-hospital-airstrike-doctors-without-borders.html?_r=0.

[26] Simon Tisdall, "Refugees are Becoming Russia's Weapon of Choice in Syria", *The Guardian*, 16 February 2016, http://www.theguardian.com/world/2016/feb/16/refugees-are-becoming-russias-weapon-of-choice-in-syria.

[27] Yasmine Hatiz, "ISIS Destroys Jonah's Tomb in Mosul, Iraq, as Militant Violence Continues", *The Huffington Post*, 25 July 2014, http://www.huffingtonpost.com/2014/07/25/isis-jonah-tomb_n_5620520.html.

[28] Abdelhak Momoun, "URGENT: ISIL Destroys the Virgin Mary Church in Mosul", *Iraqi News*, 26 July 2014; http://www.iraqinews.com/features/urgent-isil-destroys-virgin-mary-church-mosul/.

[29] "Palmyra's Temple of Bel Destroyed, says UN", *BBC*, 1 September 2015, http://www.bbc.com/news/world-middle-east-34111092.

[30] John Hall, "ISIS Begin the Destruction of Palmyra: Islamic Extremists Blow up Two Mausoleums in the Ancient Syrian City... Including One Belonging to a Descendant of the Prophet Mohammed", *Mail Online*, 23 June 2015, http://www.dailymail.co.uk/news/article-3136251/ISIS-begin-destruction-Palmyra-Islamic-extremists-blow-two-mausoleums-ancient-Syrian-city-including-one-belonging-descendant-Prophet-Mohammed.html.

[31] Abdelhak Mamoun, "ISIS Detonates Large Parts of Nineveh Historical wall", *Iraqi News*, 28 January 2015, http://www.iraqinews.com/iraq-war/isis-detonates-large-parts-nineveh-historical-wall/.

[32] Andrew Curry, "Here Are the Ancient Sites ISIS Has Damaged and Destroyed", *National Geographic*, 1 September 2015, http://news.nationalgeographic.com/2015/09/150901-isis-destruction-looting-ancient-sites-iraq-syria-archaeology/.

[33] Nasir Behzad and Daud Qarizadah, "The Man Who Helped Blow up the Bamiyan Buddhas", BBC, 12 March 2015, http://www.bbc.com/news/world-asia-31813681.

[34] Christiaan Triebert, "What OSINT Tells us about the Bakery Bombing", *Bellingcat*, 1 December 2015, https://www.bellingcat.com/?s=Bakery.

[35] "French Jets Pound Raqqa as G20 Pledges New ISIL Fight", *Al Jazeera*, 16 November 2015, http://www.aljazeera.com/news/2015/11/france-isil-raqqa-g20-151115211105532.html.

[36] "Leftover Unexploded Ordnance (UXO)", *Legacies of War*, 2 April 2016, http://legaciesofwar.org/about-laos/leftover-unexploded-ordnances-uxo/.

[37] Christiaan Triebert, "Syria's Bombed Water Infrastructure: A OSINT Inquiry", *Bellingcat*, 11 December 2015, https://www.bellingcat.com/news/mena/2015/12/11/syrias-bombed-water-infrastructure/.

[38] "Saudi-Led Warplanes Hit Yemeni Port, Aid Group Sounds Alarm", Reuters, 18 August 2015, http://www.reuters.com/article/us-yemen-security-idUSKCN0QN0HX20150819; "Airstrikes of Arab Coalition Destroyed Hodeidah Port", *Maritime News*, 19 August 2015, http://www.newsmaritime.com/2015/airstrikes-of-arab-coalition-destroyed-hodeidah-port/.

[39] "Mast: Ports in Yemen Open, but Operation Difficult", *World Maritime News*, 8 October 2015, http://worldmaritimenews.com/archives/173511/mast-ports-in-yemen-open-but-operation-difficult/.

[40] *Hodeidah: Agro-Industrial Capital of Yemen: Local Economic Development Strategy*, http://siteresources.worldbank.org/INTLED/Resources/339650-1122490529659/Hodeidah_CDS_072308.pdf, p. 6.

[41] Office for the Coordination of Humanitarian Affairs, *Yemen: Snapshot on Shipping and Food Imports*, 11 October 2015, http://reliefweb.int/sites/reliefweb.int/files/resources/Yemen-OCHA_September_shipping_report_20151011.pdf.

[42] Kareem Shaheen, "Deadly Air Strike Hits Market in Yemen", *The Guardian,* 6 July2015, http://www.theguardian.com/world/2015/jul/06/air-strike-hits-marketplace-aden-yemen.

[43] Maria Tsvetkova, "Ceasefire Brings Limited Respite for East Ukrainians", *Reuters*, 21 July 2015, http://www.reuters.com/article/us-ukraine-crisis-donetsk-idUSKCN0PV13G20150721.

[44] "Dozens Killed in Nigeria Market Bombing", *Al Jazeera*, 17 November 2015, http://www.aljazeera.com/news/2015/11/nigeria-market-bombing-151117213718605.html.

[45] Fakhri Al-Arashi, "Businessmen Demand Advance Payment for Exports to Yemen", *National Yemen*, 22 February 2015, http://nationalyemen.com/2015/02/22/businessmen-demand-advance-payment-for-exports-to-yemen/.

[46] Jonathan Saul, "Yemen war clouds raise dangers for top oil shipping route", *Reuters*, 26 March 2015, http://www.reuters.com/article/us-mideast-crisis-yemen-shipping-idUSKBN0MM2JX20150326.

[47] Christina Wille, "The Impact of Explosive Weapons on Humanitarian Access", *Aid in Danger [blog]*, December 2015, http://www.insecurityinsight.org/aidindanger/impact-of-explosive-weapons-on-humanitarian-access/.

[48] Umar Farooq, "Russian Air Strikes in Syria Choking Humanitarian Aid", *Middle East Eye*, 21 December 2015, http://www.middleeasteye.net/news/it-s-hard-imagine-conditions-getting-worse-syria-they-are-322835650?mkt_tok=3RkMMJWWfF9wsRoks6TJcu%2FhmjTEU5z1%E2%80%A6.

[49] Michael Talhami, "Effects on Essential Services'', presentation at the Explosive Weapons in Populated Areas—Humanitarian, Legal, Technical and Military Aspects expert meeting, Chavannes-de-Bogis, Switzerland, 24–25 February 2015, https://www.icrc.org/eng/assets/files/publications/icrc-002-4244.pdf, pp. 14-16.

[50] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 5.

[51] Strategic Foresight Group, *Water and Violence: Crisis of Survival in the Middle East*, 2014, http://www.strategicforesight.com/publication_pdf/63948150123-web.pdf.

[52] Dan Snow, "The Dambusters Raid: How effective Was It?", *BBC*, 15 May 2013, http://www.bbc.com/news/magazine-22510300.

[53] Alex Milner, "Mosul Dam: Why the Battle for Water Matters in Iraq', BBC, 18 August 2014, http://www.bbc.com/news/world-middle-east-28772478; Amotz Asa-El "Iraq, Syria Forced to Turn to Sea for Drinking Water", *Market Watch*, 9 July 2014, http://www.marketwatch.com/story/iraq-syria-forced-to-turn-to-sea-for-drinking-water-2014-07-09.

[54] Christiaan Triebert, "Syria's Bombed Water Infrastructure: A OSINT Inquiry", *Bellingcat*, 11 December 2015, https://www.bellingcat.com/news/mena/2015/12/11/syrias-bombed-water-infrastructure/.; "Syrian Forces Hit Islamic State in Raqqa, Destroy Water Plant", *Reuters*, 18 August 2014, http://www.reuters.com/article/us-syria-crisis-raqqa-idUSKBN0GI1CW20140818.

[55] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 15; Corey Charlton, "Air Strike on Syrian Water Plant that Left 3.5 Million People with 'Reduced' Supply Is Condemned by Charity", *Mail Online*, 3 December 2015, http://www.dailymail.co.uk/news/article-3344115/Air-strike-Syrian-water-plant-left-3-5million-people-reduced-supply-condemned-charity.html.

[56] Strategic Foresight Group, *Water and Violence: Crisis of Survival in the Middle East*, 2014, http://www.strategicforesight.com/publication_pdf/63948150123-web.pdf, p. 9.

[57] Oxfam International, "Two-thirds of People in Conflict-Hit Yemen Without Clean water", press release, 26 May 2015, https://www.oxfam.org/en/pressroom/pressreleases/2015-05-26/two-thirds-people-conflict-hit-yemen-without-clean-water.

[58] Suhaib Anjarini, "Syria: Drinking Water and War Profiteers in Aleppo', *Al Akhbar English*, 15 June 2014, http://english.al-akhbar.com/node/20189.

[59] Strategic Foresight Group, *Water and Violence: Crisis of Survival in the Middle East*, 2014, http://www.strategicforesight.com/publication_pdf/63948150123-web.pdf, p. 9.

[60] Strategic Foresight Group, *Water and Violence: Crisis of Survival in the Middle East*, 2014, http://www.strategicforesight.com/publication_pdf/63948150123-web.pdf, p. 9.

[61] Naline Malla and John Davison "Water a 'Weapon of War' in Syria's Divided Aleppo", *Reuters*, 15 October, 2015, http://uk.reuters.com/article/uk-mideast-crisis-syria-aleppo-idUKKCN0S91E220151015.

[62] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 15.

[63] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 5.

[64] "Water: Structural Demand Growth Creates Investing Opportunities", Fidelity International, 3 April 2016, https://www.fidelityinternational.com/middle-east/news-insight/21-century-themes/water.page.

[65] "Water Supply Held Back by Lack of Investment and Insurgency", *Irin*, 7 July 2005, http://www.irinnews.org/report/25245/iraq-water-supply-held-back-by-lack-of-investment-and-insurgency.

[66] *Iraq. Humanitarian Response Plan (HRP)*, United Nations Office for the Coordination of Humanitarian Affairs, June 2015, http://www.unicef.org/iraq/2015-Iraq-Humanitarian-Response-Plan_(1).pdf, p. 41.

[67] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 5.

[68] ICRC, *Bled Dry – How War in the Middle East is Bringing the Region to the Brink of a Water Catastrophe. An ICRC Report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 4.

[69] Physicians for Human Rights, *Anatomy of a Crisis. A Map of Attacks on Healthcare in Syria*, 2016, https://s3.amazonaws.com/PHR_syria_map/web/index.html.

[70] "Yemen: People are Scared of Going to Hospital", *Médecins Sans Frontières*, 25 January 2016, http://www.msf.org.uk/article/yemen-people-are-scared-of-going-to-hospital.

[71] Nora Barrows-Friedman, "Doctors evacuate patients after Israel bombs hospital", *Electronic Intifada*, 17 July 2014, https://electronicintifada.net/blogs/nora-barrows-friedman/doctors-evacuate-patients-after-israel-bombs-hospital; Allison Deger, "The Israeli Army Bombed and Destroyed Gaza's Only Rehab Hospital", *Alertnet*, 19 July, 2014, http://www.alternet.org/world/israeli-army-bombed-and-destroyed-gazas-only-rehab-hospital.

[72] Kareem Fahim, "Doctors without Borders Says Yemen Hospital is Destroyed", *The New York Times*, 27 October 2015, http://www.nytimes.com/2015/10/28/world/middleeast/doctors-without-borders-yemen-airstrikes.html?_r=0.

[73] "South Sudan: Imminent Attack Forces MSF Evacuation from Hospital", *Médecins Sans Frontières*, 9 May 2015, http://www.doctorswithoutborders.org/article/south-sudan-imminent-attack-forces-msf-evacuation-hospital.

[74] Rob Crilly, "Kunduz Hospital Bombing Could Be 'War Crime' – Latest", *The Telegraph*, 3 October 2015, http://www.telegraph.co.uk/news/worldnews/asia/afghanistan/11909123/Kunduz-Nato-investigates-whether-US-air-strike-hit-hospital-latest.html.

[75] "MSF-Supported Hospital Bombed in Northern Yemen", *Médecins Sans Frontières,* 10 January 2016, http://www.doctorswithoutborders.org/article/msf-supported-hospital-bombed-northern-yemen.

[76] Stephen Wright, "The bloodiest 24 hours yet: '18 premature babies die in Homs hospital after power cut caused by fifth day of shelling by Assad troops", *Daily Mail Online*, 9 February 2012, http://www.dailymail.co.uk/news/article-2098208/Syria-18-premature-babies-die-Homs-hospital-power-cut-caused-Assad-army-attack.html.

[77] Almgdad Mojalli, "Fuel Shortage Leads to Yemen Hospital Shutdowns", *Irin*, 5 May 2015, http://www.irinnews.org/feature/2015/05/05/fuel-shortage-leads-yemen-hospital-shutdowns.

[78] Michael Weiss, "Russia Is Bombing Ambulances in Syria", *The Daily Beast*, 10 June 2015, http://www.thedailybeast.com/articles/2015/10/06/why-are-the-russians-bombing-my-ambulances.html.

[79] "Operational Update: Gaza: Wounded People Dying while Waiting for Ambulance", *ICRC*, 5 January 2009, https://www.icrc.org/eng/resources/documents/update/palestine-update-050109.htm.

[80] Emma Gatten, "Saudi Blockade Starves Yemen of Vital Supplies, as Bombing Raids Continue", *The Independent*, 20 September 2015, http://www.independent.co.uk/news/world/middle-east/saudi-blockade-starves-yemen-of-vital-supplies-as-bombing-raids-continue-10509460.html.

[81] "Sudan: MSF Hospital Bombed in South Kordofan", *Médecins Sans Frontières*, 22 January 2015, http://www.msf.org/article/sudan-msf-hospital-bombed-south-kordofan; "Sudan: Brussels-Based Operational Centre of MSF Stops Emergency Medical Aid Following Government's Systematic Denial of Access", *Médecins Sans Frontières*, 29 January 2015, http://www.msf.org/article/sudan-brussels-based-operational-centre-msf-stops-emergency-medical-aid-following-government.

[82] "Church Hospital Bombed in Juba Mountains", *Caritas*, 5 May 2014, http://www.caritas.org/2014/05/sudan-targets-church-hospital-nuba-mountains/; Jonahhes Dietrich, "The Lone Fighter: Saving Lives along the Border of Sudan and South Sudan", *Worldcrunch*, 1 May 2014, http://www.worldcrunch.com/world-affairs/the-lone-fighter-saving-lives-along-the-border-of-sudan-and-south-sudan/c1s5196/.

[83] "Yemen: People are Scared of Going to Hospital", *Médecins Sans Frontières*, 25 January2016, http://www.msf.org.uk/article/yemen-people-are-scared-of-going-to-hospital.

[84] Jomana Karadsheh, "Iraq Works to Reverse Doctor Brain Drain", *CNN*, 29 September 2008, http://edition.cnn.com/2008/WORLD/meast/09/29/iraq.doctors/index.html?iref=mpstoryview.

[85] Nabil Alkhalisi, "The Iraqi Medical Brain Drain: A Cross-Sectional Study'' *International Journal of Health Services,* 43:2, 2013, http://www.ncbi.nlm.nih.gov/pubmed/23821910, pp. 363-78.

[86] Office for the Coordination of Humanitarian Affairs, *Humanitarian Bulletin*, Issue 22, 19 March–8 April 2013, http://bit.ly/1U8e6fj.

[87] Office for the Coordination of Humanitarian Affairs, *Occupied Palestinian Territory. Gaza Crisis. Fact and Figures*, 2016, http://www.ochaopt.org/content.aspx?id=1010361.

[88] Mark Prigg, "The Astonishing Interactive Map that Shows EVERY German Bomb Dropped on London during WW2 Blitz", *Daily Mail Online*, 6 December 2012, http://www.dailymail.co.uk/sciencetech/article-2243951/The-astonishing-interactive-map-EVERY-bomb-dropped-London-Blitz.html.

[89] Harry Garretsen, Marc Schramm and Steven Brakman, *The Strategic Bombing of German Cities During WW II and its Impact on City Growth*, Tjalling C. Koopmans Research Institute, Discussion Paper Series no. 03-09, p. 5.

[90] "Roadside Bomb Kills Team Repairing Key Iraq Bridge", *Yahoo News*, 16 August 2014, http://news.yahoo.com/roadside-bomb-kills-team-repairing-key-iraq-bridge-190736598.html.

[91] Associated Press, "Truck bomb Destroys Key Bridge in Western Iraq", *Daily News*, 17 October 2009, http://www.nydailynews.com/news/world/truck-bomb-destroys-key-bridge-western-iraq-article-1.382887.

[92] Associated Press, "Coal Miners Stuck in the Middle of Ukraine's War", *Daily Mail Online*. 31 October 2014, http://www.dailymail.co.uk/wires/ap/article-2816054/Coal-miners-stuck-middle-Ukraines-war.html.

[93] Handicap International, *Kobani: A city of Rubble and Unexploded Devices*, Fact Sheet, May 2015, http://bit.ly/1oK57oD.

[94] Aisah Gani, "Spitalfields market evacuated due to unexploded bomb", *The Guardian*, 12 November 2015, http://www.theguardian.com/uk-news/2015/nov/12/spitalfields-market-evacuated-after-unexploded-wwii-bomb-found; "10,000 evacuated after 1-ton WWII bomb found in German town", *RT*, 30 August 2015, https://www.rt.com/news/313836-germany-evacuation-ww2-bomb/.

[95] Toxic Remnants of War Network, "Blog: The Ukraine Conflict's Legacy of Environmental Damage and Pollutants", 11 May 2015, http://www.trwn.org/blog-the-ukraine-conflicts-legacy-of-environmental-damage-and-pollutants/.

[96] Toxic Remnants of War Network, "Blog: The Ukraine Conflict's Legacy of Environmental Damage and Pollutants", 11 May 2015, http://www.trwn.org/blog-the-ukraine-conflicts-legacy-of-environmental-damage-and-pollutants/.

[97] American Association for Advancement of Science, "Ancient History, Modern Destruction: Assessing the Current Status of Syria's World Heritage Sites Using High-Resolution Satellite Imagery", 2014, http://www.aaas.org/page/ancient-history-modern-destruction-assessing-current-status-syria-s-world-heritage-sites-using.

[98] Iona Craig, "The Agony of Saada", *The Intercept*, 16 November 2015, https://theintercept.com/2015/11/16/u-s-and-saudi-bombs-target-yemens-ancient-heritage/.

[99] Iona Craig, "The Agony of Saada", *The Intercept*, 16 November 2015, https://theintercept.com/2015/11/16/u-s-and-saudi-bombs-target-yemens-ancient-heritage/.

[100] Simon Bagshaw, ''Driving Displacement: Explosive Weapons in Populated Areas'', *Forced Migration Review*, Issue 41: Preventing Displacement, 2012, http://www.fmreview.org/preventing/bagshaw.html#sthash.Xo8gXAGm.dpuf.

[101] ICRC, *Bled Dry – How war in the Middle East is bringing the region to the brink of a water catastrophe. An ICRC report*, March 2015, https://www.icrc.org/en/document/bled-dry-how-war-middle-east-bringing-region-brink-water-catastrophe, p. 15.

[102] World Food Programme, United Nations High Commissioner for Refugees, and United Nations Children's Fund, *Vulnerability Assessment for Syrian Refugees in Lebanon*, 2015, http://reliefweb.int/report/lebanon/vulnerability-assessment-syrian-refugees-lebanon-2015.

[103] Security Council, UN document S/RES/1325, 31 October 2000.

[104] Security Council, UN document S/RES/1325, 31 October 2000.

[105] Gabriella Irsten, *Women and Explosive Weapons, Women's International League for Peace and Freedom*, 2014, http://www.reachingcriticalwill.org/images/documents/Publications/WEW.pdf, p. 17.

[106] John Borrie and Maya Brehm, "Enhancing Civilian Protection from Use of Explosive Weapons in Populated Areas: Building a Policy and Research Agenda", *International Review of the Red Cross*, 93:883, September 2011, https://www.icrc.org/eng/assets/files/review/2011/irrc-883-borrie-brehm.pdf.

[107] Action on Armed Violence, *Explosives States. Monitoring Explosive Weapons in 2014*, 2014, https://aoav.org.uk/wp-content/uploads/2015/06/AOAV-Explosive-States-monitoring-explosive-violence-in-2014.pdf.

[108] Action on Armed Violence. *Impact of Explosive Weapons by Gender and Age – Iraq 2003–2011*, Research Paper, 2012, http://aoav.org.uk/wp-content/uploads/2014/03/Impact-of-explosive-weapons-by-gender-and-age-Iraq-2003-2011.pdf, p. 6.

[109] Katie Stallard, "Ukraine: Long queues for aid in besieged city of Donetsk", *Sky News*, 30 January 2015, http://news.sky.com/video/1417712/people-dont-have-money-for-food; Damien Gayle, "In the bleak midwinter: Hundreds of Ukrainians forced to queue up in the snow in Donetsk as they wait for their monthly aid packages", Daily Mail Online, 4 December 2014, http://www.dailymail.co.uk/news/article-2860680/In-bleak-midwinter-Hundreds-Ukrainians-forced-queue-snow-Donetsk-wait-monthly-aid-packages.html.

[110] Harriet Sherwood, "Queue for food in Syria's Yarmouk camp shows desperation of refugees", *The Guardian*, 26 February 2014, http://www.theguardian.com/world/2014/feb/26/queue-food-syria-yarmouk-camp-desperation-refugees.

[111] Prior to displacement, most Syrians were used to a life with adequate water reserves of between 70–145 litres per person per day. For those in the refugee camp in Zaatari, they have had to adjust living with just 35 litres per person per day. Alaa Milbes, "Getting Water to Zaatari During Drought Season", *Oxfam Blog*, 19 August 2014, http://policy-practice.oxfam.org.uk/blog/2014/08/getting-water-to-zaatari-during-drought-season.

[112] Save the Children, *Explosive Weapons and Grave Violations against Children*, position paper, 2013, https://www.savethechildren.org.uk/sites/default/files/images/Explosive_Weapons_and_Grave_Violations_Against_Children.pdf, p. 12.

[113] See the WHO Long-Term Care Policy Initiative and its various outputs including: J. Brodsky, J. Habib and M. Hirschfeld (Eds), *Long-term Care in Developing Countries: Ten Case Studies*, World Health Organization (Geneva), 2003; J. Brodsky, J. Habib and M. Hirschfeld (Eds), *Key Policy Issues in Long-term Care,* World Health Organization (Geneva), 2003. Also see E. Esplen, *Gender and Care: Overview Report*, BRIDGE, Institute of Development Studies, 2009.

[114] Cate Buchanan, "Surviving Gun Violence Project", unpublished note for the UK Department for International Development on "Gender and Caregiving", 2013.

[115] Maya Brehm, "The Human Cost of Bombing Cities", *Sur International Journal on Human Rights*, vol. 22, December 2015, http://sur.conectas.org/en/issue-22/human-cost-bombing-cities/.

[116] United Nations Industrial Development Organization and United Nations Global Compact, *Engaging with the Private Sector in the Post-2015 Agenda*, 2014, https://www.unido.org/fileadmin/user_media_upgrade/Resources/Publications/Final_Consultation_Report_Engaging_with_the_Private_Sector.pdf.

[117] Asia-Europe Environment Forum, *Who Will Pay for the Sustainable Development Goals?*, 2015, http://www.asef.org/images/docs/ASEF%20-%20Who%20Will%20Pay%20for%20the%20Sustainable%20Development%20Goals_9Dec_v7%20HIGHRES.pdf, p.9.

[118] ICRC, "International Humanitarian Law and the Challenges of Contemporary Armed Conflicts", document prepared for the 32nd International Conference of the Red Cross and Red Crescent, 8–10 October 2015, http://rcrcconference.org/wp-content/uploads/sites/3/2015/10/32IC-Report-on-IHL-and-challenges-of-armed-conflicts.pdf.

[119] Brian Rappert, Richard Moyes and Iain Lang, "The Case for addressing explosive weapons. Conflict, violence and health", *Social Science & Medicine*, vol. 75, pp. 2047-2054.

[120] ICRC, "Explosive Weapons in Populated Areas – Humanitarian, Legal, Technical and Military Aspects", presentation at the Explosive Weapons in Populated Areas—Humanitarian, Legal, Technical and Military Aspects expert meeting, Chavannes-de-Bogis, Switzerland, 24–25 February 2015, https://www.icrc.org/eng/assets/files/publications/icrc-002-4244.pdf, pp. 14-16.

[121] Security Council, "Protection of Civilians in Armed Conflict. Cross-Cutting Report", Security Council Report no. 3, 20 December 2013, http://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D27-4E9C-8CD3-CF6E4FF96FF9%7D/cross_cutting_report_3_protection_of_civilians_2013.pdf, p.5.