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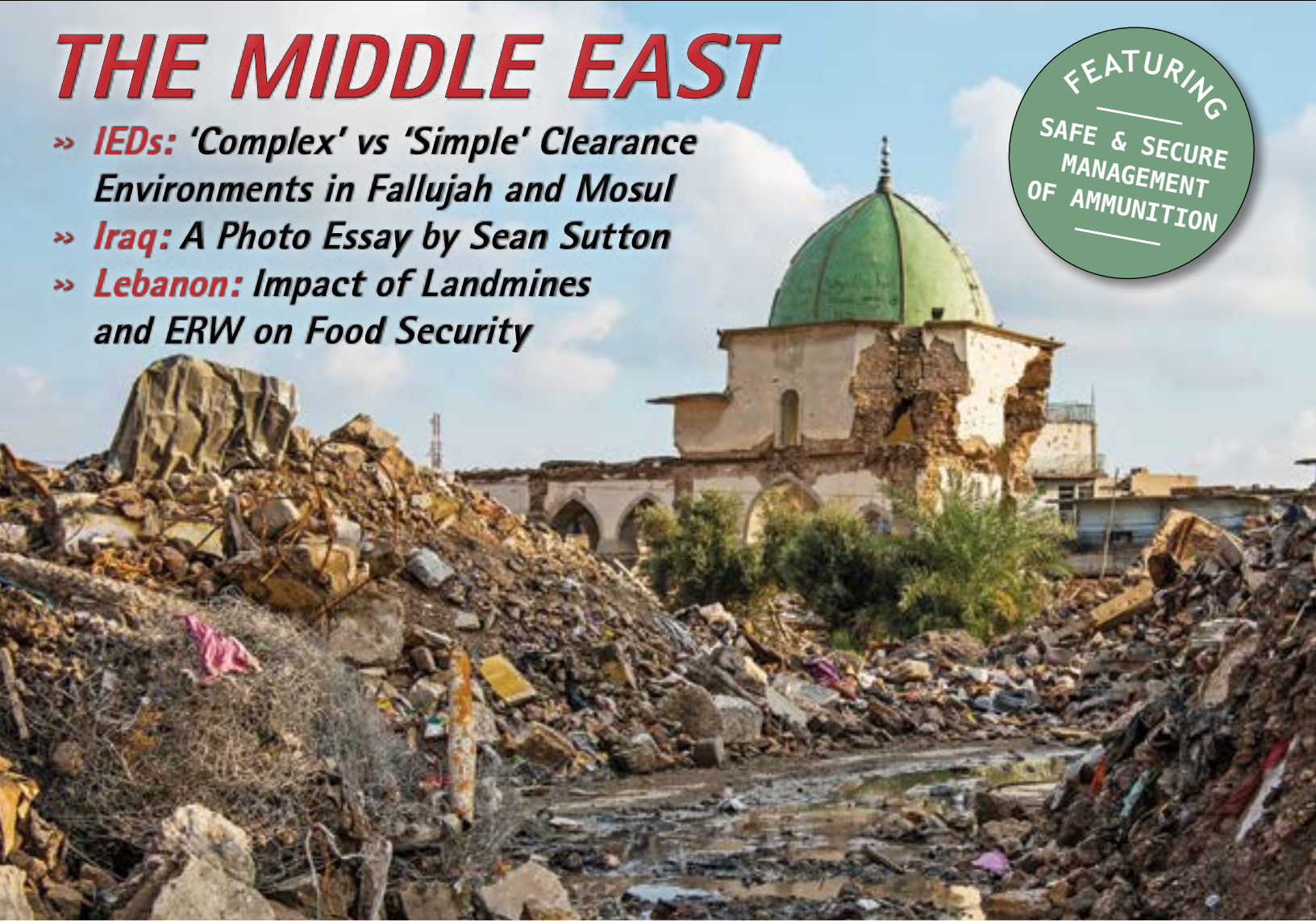
THE JOURNAL

of Conventional Weapons Destruction

THE MIDDLE EAST

- » **IEDs:** 'Complex' vs 'Simple' Clearance Environments in Fallujah and Mosul
- » **Iraq:** A Photo Essay by Sean Sutton
- » **Lebanon:** Impact of Landmines and ERW on Food Security

FEATURING
SAFE & SECURE
MANAGEMENT
OF AMMUNITION



An Editorial by Jordan's HRH Prince Mired R. Z. Al-Hussein
The **Challenge** of Managing Mine Action in **Jordan**

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ON THE COVER: The remains of the Great Mosque of al-Nuri in West Mosul, Iraq on 7 November 2018.
Photo courtesy of Cengiz Yar for UNMAS Iraq.

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- MONITORING AND EVALUATION
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The Journal of Conventional Weapons Destruction is a professional trade journal for the CWD community, including but not limited to humanitarian mine action, physical security and stockpile management, small arms and light weapons, and other related topics. It is a forum for best practices and methodologies, strategic planning, risk education and survivor assistance.

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Jennifer Risser, *Managing Editor*
CISR/James Madison University-MS4902
Harrisonburg, VA 22807
Email: cisr-journal@jmu.edu
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FROM THE DIRECTOR



Having just returned from five months of educational leave, I am energized and even more passionate about the work we have ahead of us. During my time away, I had an opportunity to study the terror that landmines caused civilians during the 1943–1944 Italian campaign and how those mines were cleared. They are stories not dissimilar from today's conflicts, including in Yemen.

On 13 June, the Embassy of the Republic of Yemen held a landmine briefing on Capitol Hill in Washington, D.C., during which I presented on the country's survivor assistance needs and Associate Director, Suzanne Fiederlein, served as the event's moderator.

In looking toward CISR's work over the next few months, from 16 September to 4 October, we will hold our 15th Senior Managers' Course (SMC) in Conventional Weapons Destruction (CWD) at our home base of James Madison University (JMU) in the beautiful Shenandoah Valley of Virginia. CISR, working in close collaboration with faculty from JMU's College of Business, specializes in management training for leaders in humanitarian mine action (HMA) and CWD around the world, including participants from Iraq, Libya, and Syria, an area of focus for this issue of *The Journal*.

We are pleased to have a number of extraordinary articles focused on the Middle East, beginning with a call to action by HRH Prince Mired R. Z. Al-Hussein titled, "The Challenge of Managing Mine Action in Jordan." In his editorial, Prince Mired outlines how Jordan embraced national ownership in its work to rid itself of landmines despite significant challenges, and discusses the country's future efforts of focusing on victim assistance, mine risk education, and training. Turning our attention to Iraq, Dr. Mark Wilkinson of the United Nations Mine Action Service presents two outstanding articles on IEDs in 'simple' and 'complex' environments, focusing on the urban areas of Fallujah and Mosul. Continuing with our focus on Iraq, we feature a photo essay by Sean Sutton on MAG's work in the country, which highlights in-depth, personal interviews with Iraqis affected by landmines. And finally, we feature an article by Henrique Garbino (FSD) on the effects of landmines on food security in Lebanon, highlighting that access denial to agricultural land and the financial burdens born by the government are the most significant challenges to food production in the country.

In addition, we feature articles on the safe and secure management of ammunition. The first article is from Matthias Krötz and Joseph Farha (BICC) on the need to develop national and regional capacities, and the second from Nora Allgaier and Samuel Paunila (GICHD) on the global challenge of managing ammunition stockpiles. Additionally, we feature an article from Roly Evans (GICHD) and David Hewitson (Fenix Insight) about the need to standardize key performance indicators in HMA, as well as an article from Robert Syfret and Chris Cooper from The HALO Trust that provides broader practical information for mine action operators on the use of thermite at field and program levels.

As we look ahead, I will be attending and participating in the Global Conference on Assistance to Victims of Anti-Personnel Mines and Other Explosive Remnants of War, and on the Rights of Persons with Disabilities in Amman, Jordan from 10–12 September, which is a focus for our upcoming calls for papers. For more information on future topics of discussion or for information about *The Journal*, please email enquiries to: cisr-journal@jmu.edu.

Ken Rutherford,
CISR Director

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The **Challenge** of Managing Mine Action in **Jordan**

by HRH Prince Mired R. Z. Al-Hussein [Chairman of the National Committee for Demining and Rehabilitation, Jordan and Special Envoy of the Anti-Personnel Mine Ban Convention]

Over the course of two decades, the Hashemite Kingdom of Jordan worked diligently to rid itself of landmines despite monumental challenges. In comparison to other mine-affected countries, the difficulties that Jordan faced may have been miniscule, but for a developing country with minimal natural resources in a very volatile region of the world, the task was enormous. The initial estimate of landmines buried in Jordanian territory was over 300,000, the vast majority of which were laid by the Jordanian military along the kingdom's western border after the 1967 Arab-Israeli War and along its northern border after the Syrian incursion into Jordan in 1970.

The simplest answer to the frequently posed question: "How did Jordan manage to do it given the circumstances?" is *national ownership*. Jordan embraced the notion wholeheartedly and strived to fulfill the obligations as set forth in the *Anti-Personnel Mine Ban Convention (APMBC)*. However, what worked in Jordan might not necessarily work elsewhere. Embracing ownership will not guarantee that resources will flow in response to needs, although it significantly encourages cooperation between those with needs and those in a position to provide assistance. This was very much the case vis-à-vis Jordan.

When I first started working on this issue in late 2004, the National Committee for Demining and Rehabilitation (NCDR) was in a difficult situation. The NCDR had been established in 2000, but there was little funding from donor countries, and the organization was struggling to survive. After changing the board and selecting a new national director, I worked on formulating a national mine action plan with

all the relevant stakeholders and made sure that it accommodated Jordan's overall national plan for development. Next we called for a general meeting with all of our potential donors and explained to them in detail what we hoped to achieve. After a great deal of discussion and negotiation, the European Union (EU) decided that it would "go out on a limb" and support us in demining a certain area in the northern part of the Jordan Valley.

From that point forward, things began to take off. Over the following years, 24 donor nations and entities provided US\$44 million in funding for Jordan to conduct clearance, training in all aspects, capacity development, mine risk education (MRE), survey, monitoring, advocacy, and survivor assistance. However, we quickly realized that if we relied solely on Jordan's Royal Engineers to conduct the demining, the task would take much longer and completion would remain a distant dream. Hence, the NCDR made the strategic decision to invite an international operator to assist with clearance efforts. In 2006, Norwegian People's Aid (NPA) dramatically changed the situation in Jordan. NPA's contribution expedited demining and put Jordan on a trajectory toward success.

As Chairman of the NCDR, I tried to imbue upon my staff the imperativeness of doing things correctly. Our challenge was to create a viable, credible, and effective civilian national authority from scratch. This could only be achieved by persistently overcoming our challenges and bureaucratic difficulties, garnering community support and involvement, and creating and fostering information networks and donor partnerships. Maintaining transparency with stakeholders and partners helped foster relationships based on trust and confidence. This

was all achieved through the hard work and political will of His Majesty the King, the Prime Minister, the relevant ministers, the Chief of Staff, and everyone else involved down to the deminer in the field. I wholeheartedly encourage mine-affected countries not to be despondent about the circumstances at hand, despite the challenges, but rather adopt the right attitude and muster the will to get the job done. The fundamentals of conducting a successful mine action program are well known and should be pursued with gusto.

Despite the tremendous efforts of our Royal Engineers and NPA, Jordan applied in 2008 for an extension to the Article 5 deadline, as the clearance of the northern border was taking much longer than we had initially anticipated. The States Parties approved this request, and Jordan, again with NPA's support, was granted an additional three years to complete the task, which it did by the spring of 2012.

A great testimony to the professionalism of NPA and the Jordanians who worked on the clearance of our northern border was the fact that there were no reported injuries among the hundreds of thousands of Syrian refugees that fled Syria on foot post-2012, as a result of the internal conflict brought on by the Arab Spring. These poor, traumatized human beings streamed across our northern border from all directions; over areas that had recently been densely contaminated with landmines. The question that bears asking is, what would have happened to all these innocent lives had we not cleared our border in time? Would they have risked breaching our minefields to save their own lives? The answer is most likely "yes."

Additionally, and as a further consequence of our commitment to owning the problem, we conducted a desk study to review the demining that was done by our military, primarily during the pre-Ottawa Convention period and after, in the Jordan Valley. The military did a phenomenal job in clearing vast areas, but during the early and mid-90s, there were neither international nor national demining standards. Hence, we were confronted with the dilemma of whether to go back and take another look at these areas that were officially declared cleared, and that were being cultivated by farmers and used for various purposes. In 2009, we decided that it was our responsibility to ensure the areas were indeed cleared. As a result of our increased capacity, technical expertise, and newly established national standards, we closely examined the "old ex-minefields" to see if any additional action would be necessary.

We called this endeavor the Sampling and Verification Project, as we were unsure what we would discover. The old ex-minefields were cleared and the lands were being utilized, but there was a discrepancy in many areas between the number of landmines originally laid and those



A map of mined areas in Jordan that appeared in Issue 5.3 of *The Journal* in 2001.

demined. After an initial assessment of the situation, we determined that the right thing to do was to authorize further investigation. We nevertheless took on this challenge with vigor and expended a big effort to verify that the minefields that were declared clear some 14 years earlier by our military were in fact clear and if any further measures were necessary, to conduct clearance expeditiously. Despite tremendous financial obstacles, the project was finally completed during the early summer of 2018.

As for victim assistance (VA), Jordan adopted a two-track policy by addressing the needs of landmine and explosive remnants of war (ERW) survivors on the one hand while also promoting the rights of all persons with disabilities in the kingdom more broadly. The needs of survivors are substantial and can always use more direct support. Despite this challenge and the limited funding available, Jordan has nevertheless afforded the vast number of landmine and ERW survivors, especially the most difficult and complicated cases, with genuine support over the years. This is done through micro-credit projects, securing employment, material and financial



HRH Prince Mired R.Z. Al-Hussein of Jordan signing the Maputo Declaration for a Mine-Free World in 2014. Photo courtesy of Wikipedia.

assistance, counseling, physical rehabilitation, providing prostheses, and other types of social support.

In 2017, Jordan enacted Law Number 20 for “The Rights of Persons with Disabilities.” This law is the most progressive human rights-based legislation in our region of the Middle East. The articles in the law are cross-cutting and place obligations on most of the government ministries vis-à-vis education, health, diagnostic testing, accessibility, voting, employment, deinstitutionalization of persons with disabilities, and their integration and inclusion into society, etc. The challenge at the moment is one of implementation. The legal framework is in place, political will stands firm, awareness of the rights of persons with disabilities in general is more widespread, and yet implementation of the law is taking time due to financial constraints. Hopefully, with the support of our donor friends and partners we will be able to make headway on these issues in the near future, whereby our landmine and ERW survivors—and all persons with disabilities and their families in the kingdom—will feel that their lives have changed for the better.

In conclusion, I would like to reaffirm my country’s unyielding commitment to this noble cause. Even though we declared completion in 2012, we still remain active in mine action. We hope to focus our efforts in the near future on VA issues, MRE, and training. As I mentioned earlier, our journey in mine action started in the early 1990s and has been a bumpy ride at times. But with the hard work and dedication

of all Jordanians who have worked tirelessly in mine action, the input of survivors, and the generosity of donors and partners, Jordan has been able to persevere and overcome the challenges. ©

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HRH Prince Mired R.Z. Al-Hussein

Chairman, National Committee for Demining and Rehabilitation, Jordan

Special envoy to the *Anti-personnel Mine Ban Convention*

HRH Prince Mired R.Z. Al-Hussein is the visiting special envoy of the *Anti-personnel Mine Ban Convention* (APMBC). He has also served as the chair of Jordan’s National Committee for Demining and Rehabilitation since 2004. After being appointed in 2009 as the special envoy to the APMBC, he has worked extensively with the United Nations and member countries to promote the banning of anti-personnel mines worldwide. In addition, since 2000 he has served as president of the Hashemite Charitable Society for Soldiers with Special Needs and is president of the Higher Council for Persons with Disabilities. Prince Mired has extensive military experience. He completed the Graduate Officers Course in Military Studies and Officer Training at the British Royal Military Academy, Sandhurst in 1990. This was preceded by two years military conscription to the Jordanian Armed Forces (1987–1989) and followed by further service to the Jordanian Armed Forces as Special Forces Officer (1990–1991); and Military Intelligence Officer (1991–1994). From 1995 to 1997 he served as Security and Intelligence Officer with Jordanian Security (1995–1997).

IED Threat Consistency and Predictability in Fallujah:

A 'SIMPLE' MODEL FOR CLEARANCE

by Mark Wilkinson, Ph.D. [United Nations Mine Action Service]

Image 1. A bridge over the Tigris River, 6 km north of Fallujah. ISIS destroyed the bridge to prevent civilians fleeing the city when the Iraqi Security Forces offensive began.
Image courtesy of UNMAS Iraq.

When in control of the area of Iraq north of Baghdad, including the city of Fallujah, ISIS prepared to defend its position from inevitable government counterattack through the widespread use of improvised explosive devices (IEDs) laid as defensive obstacles in patterns similar to conventional minefields.¹ The subsequent destruction of bridges over the Tigris River further strengthened the ability of ISIS to defend the city and prevent the civilians trapped within from escaping.

Although the Iraqi Security Forces (ISF) liberated Fallujah in May 2016, explosive hazards (EH), most significantly IEDs that lie as “weapons in wait,” continue the conflict today by depriving the Fallujah economy and society of a full recovery. For example, only after the removal of two submerged IEDs in August 2018, was the notorious Iron Bridge reopened to traffic after which a two-hour detour once again became a five-minute trip for many accessing a nearby maternity hospital.

Tasks. The bridge restoration is typical of so-called stabilization tasks in Fallujah that focus on EH clearance needed prior to restoration of essential public services and light

infrastructure.² In addition, so-called humanitarian tasks focus on clearance of IED belts composed of victim-operated IEDs (VOIEDs).

Recovery. Following clearance by the United Nations Mine Action Service (UNMAS) Iraq, from 1 October 2016 through 22 January 2019, the United Nations Development Programme (UNDP) completed 199 stabilization tasks in Fallujah and surrounding areas. These tasks were managed by the UNDP and assigned in cooperation with the Government of Iraq through the Funding Facility for Stability (FFS)—effectively a clearing house to assign and prioritize clearance tasks so as to restore key infrastructure. In addition, in cooperation with other organizations, UNMAS completed 119 humanitarian tasks.

Mandate. Gradual progress may not be progress enough, however, when considered from a public and political perspective leading to the urgency of a “sooner-than-later” mandate for those organizations including UNMAS Iraq responsible for EH clearance. Arguably, this is the critical first step toward follow-on timely repair of infrastructure and

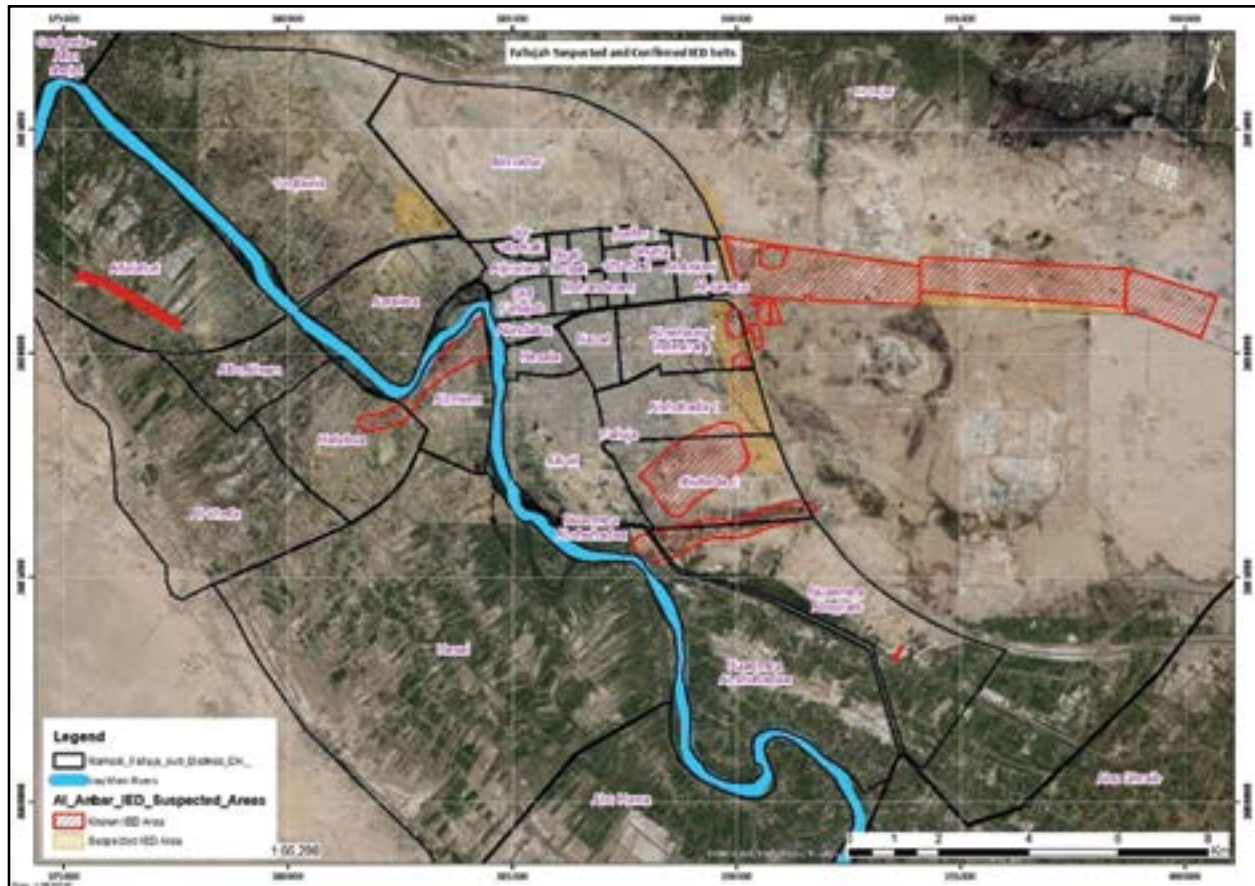


Figure 1. Known and suspected IED contamination around Fallujah (as of January 2019).
Figure courtesy of UNMAS Iraq.

ultimately the safe return home for the 1.8 million Iraqis still internally displaced, many living in camps. Such a mandate immediately leads to practical problems insofar as IED disposal (IEDD) operators need to understand the threats faced from two aspects: type and environment.

Implications. IEDD operators must identify and classify threats, consolidate and interpret related data, and thereby assess the threat environment. The more effectively the IEDD operators can draw practical conclusions about both the threats and the threat environments, the sooner they can

safely commence clearance activities. Moreover, the IEDD community can then learn how to optimize clearance assets. This then leads to two questions concerning EH clearance in Fallujah:

1. What can the data tell us about the extent and type of IEDs encountered?³
2. What might the data contribute to the threat environment model?

Findings. UNMAS Iraq clearance data compiled during activities in Fallujah leads to three conclusions key to assessing



Images 2 and 3. Typical plastic (left) and “speed bump” (right) main charge containers in Fallujah.
Images courtesy of UNMAS Iraq.



Image 4. A typical IED obstacle belt on the outskirts of Fallujah.

Image courtesy of UNMAS Iraq.

and managing on-going clearance tasks and deployment of clearance assets in Fallujah:^{4,5}

1. **Technical.** Most IEDs found in Fallujah have been victim-operated (high-metal content pressure plate) devices, only occasionally fitted with anti-lift devices.
2. **Threat.** The EH environment can be defined as relatively simple when compared to other areas of Iraq (see accompanying article, page 13).
3. **Coverage.** The amount and extent of contamination remains the biggest clearance problem.

Basis. EH clearance tasks completed by UNMAS Iraq since October 2016 provide a basis for the conclusions drawn regarding threat type, environment, and coverage. UNMAS Iraq operators cleared a total of 568 complete IEDs along with 1,139 other explosive remnants of war (ERW) from a coverage area of 2,586,546 sq m and safely removed another 4,384 IED main charges and components from this same area. In addition, UNMAS Iraq rendered safe and handed over to ISF nearly 10,000 kg of IED explosive content for destruction.

Components. Almost without exception, the IEDs recovered in Fallujah are victim-operated (VO) and crudely manufactured, but effective. The most common type uses a plastic container such as a commercial jerry can filled with 10–20 kg of ammonium nitrate and aluminum-based homemade explosive (HME), high-metal contract pressure plate(s), a 9-volt battery, detonating cord of varying length, and a commercially-manufactured electrical detonator. A common variant uses a crudely-fabricated, low-grade, steel-flattened box (colloquially known as an “explosive speed bump”) for the main charge filled with the same weight and types of explosive. In the explosive speed bump variant, the explosive is often wrapped in a plastic bag to protect against weathering.

In most known cases, these devices are laid in large numbers in linear patterns of 5-to-10 m spacing, in some cases

extending 10 km, and sometimes adding multiple rows for density. A location in the al-Shuhada area of Fallujah (see Image 4) illustrates a two-row deep pattern with five plastic jerry can type main charges visible (shown with red circles to the right) representing the first row and a single main charge (to the left) representing part of a second row. The presence of buildings in the background (indicated by the black arrow) illustrates the proximity of EH contamination to residential areas.

Switches. Nearly all VOIEDs recovered in Fallujah are triggered by pressure plates made from two flexible steel strips, averaging 60 cm in length, 3 cm in width, and 4 mm thickness. The two strips are normally separated by a spacer such as a piece of wood, leaving a distance of around 1.5 cm between the steel strips to be closed for the switch to function. Most recovered pressure plates have been wrapped in black rubber such as an inner tube from a vehicle tire or plastic for weatherproofing. There is usually little attempt to camouflage the switches other than to bury them, normally to a depth of 5 cm beneath the surface. Sometimes several pressure plates will be discovered in close proximity wrapped in the same color plastic and type suggesting a bulk manufacturing process.

Some VOIEDs feature an additional VO switch often called a *crush wire contact* or “rosary beads.” The beads



Image 5. A pressure plate wrapped in orange plastic discovered in Fallujah.

Image courtesy of UNMAS Iraq.

refer to tiny open switches spaced at 10–30 cm intervals along lacquered wire insulated by clear plastic tubing. The entire switch can exceed 10 m in length. While more prevalent in complex and urban environments, they account for roughly five percent of switches used



Image 6. A typical crush wire contact. Several dozen switches like this may be present on lengths of lacquered wire up to 10 m in length.⁷

Image courtesy of www.iedawareness.com.

on VOIEDS recovered from Fallujah's contaminated areas to date, according to knowledgeable operators' anecdotal reports. To the untrained person, these can be difficult to locate visually or with a metal detector (see Image 5).

Batteries are occasionally found as the spacer inside pressure plates but more often are simply wrapped in tape for weatherproofing and lie close to the main charge, again subsurface. Voltage checks on a small number of recovered batteries have revealed charges of a full 9-volts present, suggesting that most IEDs present are likely viable devices.

Main charges are usually buried separated from the battery by a distance of up to 2 m, again at a depth of around 5 cm. Some devices have been recovered with double pressure plates to a single main charge, others with double main charges from the same pressure plate. Whatever the variant, devices tend to be found in groups of identical devices and similarly spaced to those as already described. Operators in Fallujah have found and neutralized a number of VOIEDs equipped with anti-handling devices of three types.

Type 1 is fabricated from a plastic electrical box approximately 10 cm squared and 5 cm deep with a rocker-type switch protruding from one face and laid subsurface typically 20 cm from the main charge. When set, the switch is held down by a brick or rock that, in most cases, is obviously and clearly out of place. The switch can be closed by removing the brick or rock, as well as stepping on the pressure plate, probably targeting a tendency of novice operators to clear the area around a suspected IED before beginning render safe procedures (RSPs).

Type 2 uses the same pressure release mechanism but situates the switch underneath the main charge container. This method, recovered from several neutralized IEDs in Fallujah, targets an IED operator or virtually anyone else discovering and lifting the main charge from the ground. While the switch is easily discovered by a trained IED operator, for the less experienced or untrained person it can exploit actions that might lead them to believe a device is safe when it is not— for example, by severing the physical link to the switch.

Type 3, a rarely used variant, configures the pressure plate vertically. This type has been used to target mechanical assets and their operators, in particular bulldozers that have been used to breach IED belts. These pressure plates are similar to but much smaller than (no more than 30 cm in length) Types 1 and 2. Type 3 variants are also buried much deeper (normally 10–15 cm). Setting them in a vertical plane and placed in locations where ISIS anticipated bulldozers might be used to move earth (for example, in tracks) allows for the targeting of valuable mechanical assets, initiating the IED when they are pushed aside with earth. While the main charges recovered in Fallujah are not large enough to destroy armored vehicles, they can cause extensive damage.

Although currently there is no accurate data on the precise numbers of anti-lift switches recovered, anecdotal evidence from interviews with international IEDD operators suggests that less than 10 percent of IEDs recovered to date are fitted with these devices.

Consistency. There is certainly sufficient evidence from an analysis of the 568 IEDs recovered to date from Fallujah by UNMAS Iraq operators to draw a number of conclusions, all relating to consistencies.

First, the design of pressure plates and main charges (either plastic or the explosive speed bump variant) is normally the same. This suggests that a deliberate and well-planned production facility existed and was capable of manufacturing a large number of pressure plates and main charges with a relatively high standard of design and reliability.

Second, the configuration of the device in the ground is normally similar enough to be predictable. In a given line of IEDs, it is extremely unusual to find a device where the switch, main

charge, and power source are not located in the same layout. This suggests that these IEDs are probably laid by relatively unskilled persons taught to emplace the IEDs through a series of steps or rules as a drill.



Images 7 and 8. An in-place anti-lift switch. Note the presence of the rock on the anti-handling switch and the proximity of that switch to the main charge.

Images courtesy of UNMAS Iraq.

Third, the IED belts in Fallujah reveal a remarkable consistency in their pattern not unlike Warsaw Pact tactics for establishing defensive minefields. Given the quantities and types of Soviet equipment used by Saddam's Iraqi Army, it is reasonable to assume some individuals trained in conventional methods for laying minefields later offered their services to ISIS.

Implications. What might the community conclude from the data related to the work done in Fallujah concerning the types and locations of IEDs rendered safe? To answer this question, operators need to evaluate their findings relative to the environment and RSPs. On that basis, the findings related to work in Fallujah show consistent and predictable patterns useful in planning, conducting clearance operations, and managing clearance assets efficiently.

Model. These consistent and predictable qualities argue for and help to define what the community might term a simple model. Several factors support this argument:

1. **Location.** IEDs were deployed in belts by ISIS on the periphery of Fallujah for a clear purpose, namely to stall any ISF assault. In these mostly rural areas, the ground could be dug easily and quickly for emplacement purposes.
2. **Clutter.** Although the defensive belts often cut through open ground adjacent to residential and other built-up areas, they otherwise tend to be relatively clean, with little surface or subsurface metallic contamination present other than occasional items of unexploded ordnance (UXO) and associated scrap metal such as mortar-tail sections.
3. **Dimension.** Except on rare occasions—classified as the Type 3 IED that uses a vertical pressure plate switch and thereby could be viewed as a three-dimensional threat—almost all IEDs in Fallujah are two-dimensional threats located either at the surface or subsurface with clear implications for RSPs.
4. **Degradation.** IEDs are susceptible to degradation for reason of seasonal variations in weather, in particular the cumulative effect of repeated heavy rainfall and flooding. The impact of weathering is especially noticeable on ammonium nitrate-based explosives. Numerous main charges recovered have shown both plastic and metal casings shattered by explosives expanding as they absorb water. Type 2 IEDs' (explosive speed bumps) main charges are also susceptible to rapid oxidation of the casings with many severely corroded.
5. **Exposure.** IED pressure plates often can be found in the open and on the surface due to the action of rain water washing away less compacted earth covering them.
6. **Human.** Local residents who either have witnessed, have

roles in setting IEDs, or have knowledge of their existence have proven to be a significant source of information concerning details on locations and emplacement methods, contributing to Non-technical Surveys as well as subsequent clearance operations.

7. **Render Safe.** In terms of neutralization and RSPs, analysis of recovered IEDs strengthens an argument that this is a simple environment for three reasons.
 - » **Easy to locate.** Standard metal detection equipment can identify extremely strong metal signatures from the ubiquitous high-metal content pressure plate
 - » **Signature.** Detector heads can localize and define the size of the signature, often defining the pressure plate before any manual intervention takes place
 - » **Visual.** Even the crush wire contact switch has proved relatively easy to detect by trained personnel, firstly by using the naked eye and secondly by detecting a strong signature via the Minelab F3 Compact used by the majority of UNMAS High Risk Search Teams in Fallujah.⁷

Given the relatively "clean" environment these IEDs exist within, as well as the identification and cancellation of spurious contacts (including UXO scrap such as shrapnel), RSPs are normally a relatively simple and quick process.

Conclusion

In summary, consistency and relative simplicity of device design and layout as described greatly facilitate RSPs in Fallujah. Where an IED operator is working within an established IED belt, the consistency of the device's linear pattern, regular spacing, and makeup is usually obvious. This then gives search teams, team leaders, and IED operators a degree of confidence in planning and conducting clearance activities.

Exceptions. Where secondary switches are incorporated into devices, their presence so far has been obvious. For switches utilizing a brick or rock to encourage pressure release, a pair of wires can easily be located running from the suspected switch location toward the main charge. For pressure release switches, the careful fingertip exploration of the area around the suspected main charge normally identifies wires running from the detonator (always found on the top of the main charges) to the underside of the main charge container. Regardless of the presence of anti-handling switches, RSPs remain relatively easy. IED operators identify the location of the IED's component parts and then take semi-remote action against either the power source or the detonator. A careful fingertip isolation of the switch, main charge, and any other suspected component easily allows them to



Image 9. Four complete VOIEDs neutralized by a local national IED operator in the al Shuhada district of Fallujah on 24 January 2019.

Image courtesy of UNMAS.

negate the presence of additional detonators or power sources prior to semi-remotely breaking the circuit. Hook-and-line procedures further reduce any residual risk to search teams in completing the neutralization of devices.

Skills. The simple environment model has implications for operations transferred to local national personnel when appropriately trained. Based on collected data and UNMAS-documented operations, and the types of devices encountered, both search and RSPs can be broken down into simple, basic drills that can be taught, practiced, and assessed for relatively inexperienced personnel. According to a year-long pilot study, after a six-week training course led by experienced international technical advisors, a cadre of predominantly former-ISF, IED-operator recruits deployed as members of two Rapid Response Teams to Fallujah where their work was monitored and found successful in terms of IEDs located and rendered safe.

Variables. An assessment of UNMAS data compiled from Fallujah suggests three variables define a simple environment model for conducting IED clearance both there and in similar environments. Moreover, it suggests a simple environment model could benefit from a second order analysis and evaluation of data related to interaction of these three variables.

Caveat. The simple environment model, like all models, depends upon assumptions and conditions continuing without change, which may not be the case for at least two reasons. First, the ISF previously conducted render-safe clearance of some IED belts near Fallujah according to military standards and under combat conditions, which necessitates an approach different from humanitarian standards. In many cases, these military RSPs require only the removal of detonators, probably by hand, while leaving the charge in place, which, within the context of humanitarian clearance standards constitutes a potential threat. Second, evidence suggests that Iraq is not yet a fully post-conflict environment insofar as IEDs continue to be



Image 10. A local national IEDD operator shows the results of his day's work in Fallujah.

Image courtesy of UNMAS.

placed by ISIS operatives. Such old and new threats make continuing threat assessments necessary to ensure that processes in use are not likely to be exploited by any belligerent forces.

Applicability. EH clearance operations, particularly in high-threat and IED-laden contexts containing complex environments such as in Mosul (see companion article, page 13) are, by definition, extremely expensive compared to relatively simple environments such as Fallujah. Given the number of IEDs, the worldwide effort to address clearance in a timely, cost-effective way while protecting operators has become a matter for further data analysis and revised models. Effective business plans need to start with solid, applicable field experience quantified by data and driving an operational concept. To date, the UNMAS Iraq experience in Fallujah says this is possible even in the short term and is already being tried and has proven to be a working concept. ©

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Mark Wilkinson, Ph.D.

Explosive Hazard Management Team Leader
United Nations Mine Action Service (Iraq)



Mark Wilkinson, Ph.D., a UNMAS (Iraq) Explosive Hazard Management Team Leader, has 20 years of professional experience in military and humanitarian mine action (HMA). As a former British Army Ammunition Technical Officer, he worked as a High Threat IEDD Operator in several operational environments before transitioning to HMA. His HMA experience has developed through time spent as an IEDD operator, then a program manager, before transitioning to UNMAS. His academic background includes a master's degree in global security and a doctorate in politics and international studies. His thesis on Arms Control and Intelligence has been published internationally as the book *Before Intelligence Failed*. He is also a Visiting Fellow at the University of Nottingham Centre for Conflict, Security and Terrorism where he maintains an active research agenda.

IEDS AND URBAN CLEARANCE VARIABLES IN MOSUL:



DEFINING COMPLEX ENVIRONMENTS

by Mark Wilkinson, Ph.D. [United Nations Mine Action Service]

Al-Maedan, west Mosul, May 2018.
All images courtesy of UNMAS Iraq.

More than any other post-conflict environment in Iraq, the complexity of west Mosul and its improvised explosive device (IED) threat challenges our fundamental perceptions and definitions of mine action. From here, 400 km north of Baghdad in the al-Maedan District on the west side of the Tigris River, ISIS ran its caliphate and made its ill-fated last stand against attacking Iraqi Security Forces (ISF).

Context. Clearance operations began in east Mosul even as the battle in west Mosul drew to a close. Nearly two years later, the al-Maedan District in west Mosul remains in ruins, heavily contaminated by explosive hazards (EH), and has served as a virtual laboratory for real time study of EH clearance in a *complex*, urban environment, which begs the question: what makes it complex?¹ In a word, context. This influences render-safe procedures (RSPs) as determined by pre-event, event, and post-event phases, along with their respective physical and political factors.

Reality. Why post-event and not-post conflict? Because the conflict continues. Even as UNMAS Iraq operators and others undertake ostensibly humanitarian clearance tasks,

they remain under ISIS threat, subject to last-minute mission changes based on daily intelligence reports. Sometimes clearance personnel are targeted because they are perceived as part of an opposing, active military force by the very populations they serve.

Objective. According to current U.N. intelligence estimates, between 20,000 and 30,000 ISIS insurgents remain in Iraq.² Their tactics may have changed, but their intent remains the same: regain control of territory actively through guerilla tactics and intimidation; and passively through their deployed IEDs. Until cleared, these IEDs contribute to “destabilization” insofar as they deny access to and repair of infrastructure and the rehabilitation of homes.³

Outcome. When viewed from an outcome perspective, IEDs are less explosive remnants of war (ERW) and more “passive attack” weapons, part of a strategy that is both defensive and offensive at the same time. So long as IEDs remain in place, and thereby stall repair of infrastructure and important cultural assets—such as mosques and churches—they ultimately lead to a political outcome. Despite strong evidence of progress and the on-going recovery in east Mosul and

elsewhere, returnees living with threats and 1.8 million internally displaced persons (IDPs), mostly living in camps, blame the government for their plight. Those not already benefiting from progress to date are dissatisfied and vulnerable to ISIS propaganda.⁴

Factors. RSPs as a function of tactics, type, design, and location and/or placement of IED types depend upon context. Therefore, to understand EH clearance in west Mosul, the community needs to understand the adversaries: their objectives, strategy, tactics, weapons of choice, and how these were used over time. The al-Maedan District of west Mosul serves as a kind of “time capsule” wherein operators can differentiate the three phases already mentioned: pre-event, event, and post-event. Clearance operations to date document the following as contributing factors to complex urban environments for EH clearance:

PRE-EVENT FACTORS

- **Design.** IEDs cleared from sites in Mosul to date can be characterized by range and level of technical complexity suggesting extremely competent and capable design and manufacturing facilities.⁵
- **Detonation.** ISIS manufactured timed, victim-operated, command-initiated devices to support conventional combat tactics and to enhance combat effectiveness or delay/harass opposing forces.

EVENT FACTORS

- **Distribution.** ISIS deployed thousands of IEDs targeting combatants during the 2017 battle to liberate Mosul; these contaminate the remains of completely- or nearly-destroyed buildings and massive amounts of debris estimated at more than 7 million tons.
- **Density.** ISIS relied on IEDs to defend its forces as they withdrew to tighter defensive perimeters in west Mosul; mapping the geography of fighting is a strong indicator useful in directing post-event survey and assessment of EH types and amounts.

POST-EVENT FACTORS

- **Dimension.** More than any other factor, victim-operated IEDs (VOIEDs) hidden in walls, air conditioning units, or under garments hanging on pegs add a third dimension to urban environment clearance, further complicated by narrow streets, piles of debris, and the restricting maneuverability of mechanical assets.
- **Biologic.** Nearly two years after the battle for west Mosul, operators still find deceased victims wearing

suicide belts by the hundreds, which pose both explosive and biologic threats as well as the need for protection and coordination of the return of the remains.

- **Security.** ISIS continues to use VOIEDs as booby-traps to deny access to ostensibly liberated areas by indiscriminately targeting noncombatants as part of an on-going guerilla campaign that includes the harassment, abduction, and murder of the local population. Meanwhile, clearance teams remain targets for both IED and small arms attacks.

Lethality. If these factors can be measured as variables, then the UNMAS experience and data compiled from the west Mosul clearance operations provides a baseline for formative thinking related to a proposed *lethality index*, first to measure complex environments and, second, to help optimize clearance skillsets and levels appropriate for still-to-be-defined new doctrine and standards currently lacking in the humanitarian mine action community.

Progression. After liberation in October 2017, most UNMAS clearance teams assigned both explosive ordnance disposal (EOD) and IED experts to focus on emergency, first-responder-type tasks. Where it was safe to do so, UNMAS used these emergency tasks to focus on areas of the city most affected by fighting to safely remove the most obvious EH hazards consistent with U.N. stabilization and humanitarian initiatives.

Volume. As of 30 January 2019, UNMAS operators had conducted 3,564 conventional EOD tasks and rendered safe a range of conventional threats, including mortars, rockets, projectiles, grenades, and 21 air-dropped munitions and guided missiles. While small arms and pyrotechnics clearly do not represent the same level of hazard to local populations as other types of conventional ordnance, in order to eliminate the subsequent reuse by ISIS, they cannot be ignored. As of 30 January 2019, UNMAS operators had removed and rendered safe for disposal a grand total of 651,039 threats of all types.^{6,7}

Categories. As of 30 January 2019, UNMAS operators had completed 1,092 IED tasks in Mosul alone, and rendered safe and removed 25,302 IEDs of all types (including component parts such as main charges or switches alone), ranging in sophistication from simple and crude devices to technically sophisticated and innovative based on their delivery method.⁷ While IEDs normally are classified as a function of their means of initiation (time, victim-operated, or command-initiated), this classification does not facilitate a broader analysis of IED contamination in Mosul. In simple terms, ISIS developed IEDs to reflect three categories of operational requirements:



ISIS 210 mm and 120 mm mortar bombs. Note the quality control stickers on the tail sections of the 120 mm mortar bombs (center left).

1. To support conventional combat with improvised substitutes for commercial military munitions and ordnance.
2. To enhance combat effectiveness through the integration of improvised weapons into existing force structures.
3. To delay and harass advancing ISF.

Manufacture. ISIS achieved a level, scale, and quality of arms manufacturing—including IEDs—equivalent to conventional arms manufacturers. For example, ISIS manufactured 120 mm mortar bombs to tolerances that—at least at a superficial examination—are all but indistinguishable from weapons commercially-manufactured to military specifications and standards. ISIS 120 mm mortar bombs were recovered containing high-explosive (HE) and chemical fills such as mustard gas. Many unfired bombs were recovered with quality-assurance labels attached illustrating what was a technically-advanced manufacturing and acceptance process. A total of 343 ISIS-manufactured mortars were recovered, including the larger 210 mm variants, with most being rendered safe and recovered for subsequent disposal.

Fuzes. ISIS also developed a range of fuzes. Like their mortars, these show remarkable consistency based on their simple but effective action mechanisms. All improvised fuzes

recovered by UNMAS operators have been point detonating, manufactured from machined aluminum or plastic, often with simple creep springs retaining strikers into modified nonelectrical detonators. Evidence gathered from west Mosul shows that several variants of ISIS fuzes have been used on ordnance ranging from mortars to air-delivered munitions and rockets.

Modifications. ISIS also modified other common conventional munitions, including the ubiquitous 40 mm grenade found in several modified forms. The most common variation replaces a factory fitted fuze with fully improvised point detonating variants; or a second, common modification to the existing fuze allows use of the munition as an air-dropped grenade from drones, or simply thrown by hand.

Air-dropped Munitions.

The ISIS air-delivered aerial munition (ADIM) is yet another variant of the modified 40 mm grenade-type weapon, designed to be paired with the existing range of ISIS fuzes and attached to a plastic body. Explosive fills encountered have included HE, ammonium nitrate-based explosives, and modified 23 mm high-explosive incendiary projectiles for use as hand-thrown and drone-dropped weapons.



Typical ISIS improvised point detonating fuzes (IDPF).

Suicide Belts. UNMAS operators recovered and rendered safe 1,142 suicide belts and vests in west Mosul, many still strapped to the remains of ISIS fighters. These weapons also show remarkably consistent design, utilizing UZRGM-type fuzes (both homemade and military) directly attached by detonating cord taped around HE, normally with added ball-bearing type fragmentation. These devices are almost always recovered in military-style webbing belts and pouches. Clearly a weapon of last resort for the fighter wearing them, logically they would be self-initiated when either being overrun by ISF or while storming fortified positions.

Enhancements. UNMAS operators found and rendered safe numerous IEDs designed to improve the combat effectiveness and firepower of ISIS fighters. Evidence to date shows these weapons fall into one of two categories: improvised/modified rockets and vehicle-delivered explosives. The technical sophistication of many of these IEDs is impressive, both in terms of design and explosive effect. Many improvised rocket designs also integrated chemical weapons (normally low-grade mustard gas) into their warheads.

Launchers. ISIS improvised-rocket designs have been analyzed in detail by a number of organizations, including UNMAS.⁸ In one specific clearance operation alone at the al-Shifa hospital complex in west Mosul, UNMAS operators recovered and rendered safe nearly 100 improvised-rocket launchers along with a large number of used launchers. UNMAS identified and assessed four launcher variants that probably entered service in early 2017. Two of the variants contain PG-7 and PG-9LR, the other two containing PG-9SR and a *thermobaric*-type projectile. In reality, the ISIS designated thermobaric warhead is simply another high-explosive projectile. Launchers share as common design features a hand-grip assembly, a 9-volt direct current (DC) power source, tube diameter, improvised-fin assembly, and internal configurations (projectile or rocket, improvised propelling charge, and counter-mass); however, the sighting system can vary.⁹ While the launchers are intended to be disposable, ISIS instruction sheets recovered by UNMAS operators tell users to retain and return the launchers, presumably for refill. ISIS videos circulating in 2017 showed what appeared to be rockets being loaded into launchers under apparently sterile conditions.¹⁰ Evaluation of these launchers, along with anecdotal evidence of their use in Mosul strongly suggests that these launchers were developed to be integrated into infantry-type fighting in urban environments such as Mosul. The ISIS-designated thermobaric warhead would seem to be specifically designed to attempt to enhance blast effects, particularly when used in buildings.



An ISIS-modified, 40 mm high-explosive, dual purpose grenade, probably intended for hand delivery.



Typical ISIS ADIMs with ISIS-variant point-detonating fuzes attached. Note the driving band of the 23 mm projectile visible through the body of the third ADIM from the left.



A typical ISIS suicide belt recovered in west Mosul. Note the dual UZRGM-type fuzes and the added fragmentation around the pouch-sized main charges.



Four variants of ISIS improvised rockets, all recovered by UNMAS in west Mosul.

Vehicles. UNMAS operators also recovered and rendered safe several vehicle-borne IEDs (VBIEDs) from west Mosul; several others were located in cleared piles of destroyed vehicles placed in scrap heaps by ISF mechanical-handling equipment, e.g., diggers, earthmovers. Other confirmed VBIEDs still remain, as the precarious states of partly-destroyed buildings have prevented access for safe disposal. Again, the design suggests their intended purpose was to enhance combat operations. Variants were rendered safe with both manual (suicide) and remote detonation mechanisms and explosive effects with the aim of inflicting mass casualties (via large explosive payloads) as well as more targeted attacks via concealed improvised explosively-formed penetrator (EFP) type devices.

Switches. ISIS manufactured time-based, command-initiated, and victim-operated devices from its factories in west Mosul, and then deployed these as part of a delay-and-harass defense strategy against any ISF assault.

- **Time-based.** Although UNMAS operators have yet to recover a complete and intact time-based IED, based on timer components recovered and analyzed to date, ISIS likely deployed a limited number of time-based IEDs. Again, analysis of the time-based IED components shows a standard ISIS manufacturing technique: brown-plastic boxes with hot glue-sealed lids form the basis of time switches; written instructions describe how to set time delays of up to 90 minutes. Some variants include electrical “safe-to-arm” switches as well as multiple 9-volt DC batteries wired in both series and parallel,

obviously to match the intended power requirements of the attached circuitry or detonators. Once again, the only confirmed timer components discovered and recovered by UNMAS operators in Iraq have been from west Mosul.¹¹

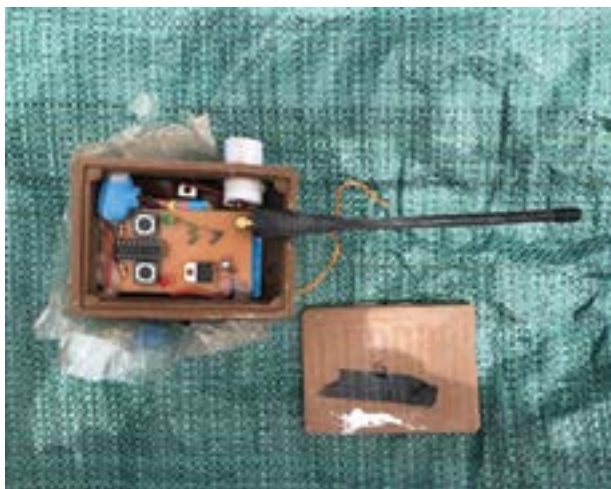
- **Command-initiated devices** deployed by ISIS in west Mosul used both wire and remote-controlled (RC) systems. Evidence from command-wire-type devices rendered safe by UNMAS operators feature relatively short lengths of command wire, suggesting they were used to carefully and accurately target passing ISF foot or vehicle patrols, probably with follow-up small arms action. This further suggests that ISIS planned and executed complex ambushes as ISF advanced into west Mosul. Main charges used in command-wire IEDs feature large EFP and “platter-type designs” to enhance explosive effect, also giving an ability to effectively attack armored vehicles.
- **Remote-control.** UNMAS analysis of three types of devices recovered by UNMAS operators in west Mosul:
 1. **Long Range Cordless Telephone (LRCT).** Relatively few LRCT devices have been recovered, probably due to the fact that they quickly became obsolete as the growing mobile telephone network in Mosul City was utilized for longer range and more reliable communications.
 2. **Dual Tone Modulated Frequency (DTMF)** devices have also been used in relatively small numbers based on evidence to date. These devices require entry of coded numbers into a handset and transmission for activation and thereby provide a high degree of protection against accidental initiation; however, they are highly susceptible to electronic counter measures as well as environmental conditions such as degradation to power sources due to weather and time, much like LRCTs.
 3. **Mobile Telephones** appear to be a default choice for ISIS when integrating remote-control switches into IED designs.

Modifications. Recovered mobile telephones (normally basic, low-cost handsets) were modified in several ways. Internal antennas were replaced and devices have additional power sources and circuitry to initiate attached electrical detonators.

Among the most sophisticated integration of mobile telephones into IEDs is their use as arming mechanisms for passive infrared (PIR) victim-operated devices. These designs were recovered from a range of locations, including buildings



A typical ISIS mechanical timer recovered by UNMAS in west Mosul.



A typical ISIS DTMF recovered by UNMAS in west Mosul.

where they were connected to large numbers of 9-volt DC batteries thus providing an extended life as an active IED. One IED successfully rendered safe by UNMAS contained 22 batteries connected to a Nokia mobile telephone that acted as an arming switch for the PIR sensor.

The dangers in rendering safe any IED containing a PIR switch are considerable. While many recovered devices have contained batteries with insufficient remaining current to initiate the attached detonator, others did not. In these cases, it is likely that other component failure or environmental factors prevented these devices from functioning.

Victim operated. A range of other victim operated devices were rendered safe by UNMAS in west Mosul. In many cases, these are deployed to target personnel and are sometimes used to build anti-handling devices into IEDs. Tripwire-type devices have used clear fishing twine, usually laid across doorways, pathways, or other obvious choke points. One

variant encountered used medical syringes; when force is applied to the attached fishing twine, the switch contained within the syringe is closed, thus completing an electrical circuit and initiating the attached IED. Another used integrated “push-pull” toggle switches with fishing twine. As with the syringes, these toggle switches were recovered from tripwire IEDs and as bulk components. Both of these switches suggest a clear intent on the part of ISIS to target EOD and IEDD personnel in operations following the expected liberation of Mosul.

What is clear from the range of IEDs and associated components recovered from Mosul is that ISIS effectively produced and deployed a wide-ranging and technically-sophisticated IED threat, representing the entire spectrum of time, victim-operated, command-initiated, and projected-IED capabilities.

Three dimensions. What does this mean in terms of applying existing humanitarian mine action (HMA) doctrine to the complex EH situation in Mosul? Or, what makes Mosul different?

First, the EH environment is a three-dimensional problem. EH have been located in sub-surface, surface, and vertical/aerial pockets (walls, ceilings, and improvised air-dropped munitions). The prevalence of metal in the urban environment, in particular reinforcement bar (rebar) in



A Nokia mobile telephone attached to a plastic container with 22 9-volt DC batteries inside (top). Mobile telephones also have been used as arming switches for attached PIR devices (bottom).



An ISIS “push-pull” toggle switch before and after removal of tape.

concrete, makes search activities that rely on metal detection extremely difficult.

Second, where the environment degrades detector capabilities, the combination of visual recognition and experience (i.e., knowing what to look for) become key factors. Safe and efficient clearance depends upon highly-trained search personnel being able to quickly differentiate between innocuous items and those requiring further investigation. Effectively, experience gained from each search contributes to planning for the next, to include deployment of search teams and assets.

Third, threat assessment is usually considered to be an active and dynamic process, but the formulation of a threat assessment in post-event Mosul arguably alters the normal relationship between the assessed intent, capability, and location available to the individual laying the IED.¹² Therefore, the key challenge to any IED render-safe operation is knowing the type of device, its method of initiation, layout, and fabrication.

Reconnaissance. Within a “conventional” setting, threat information can normally be established via questioning of witnesses. However, in west Mosul, local people were often not present in their homes when IEDs were laid,

and many devices were moved as a result of mechanical-handling equipment activity or simply exposed due to environmental changes. This leads to the logical question “What about robots?” No current UNMAS implementing partner uses robots for IEDD support, partly due to the cost of even small robots, partly for operational difficulties in urban settings, and partly due to the limited (nonexplosive) actions that can be safely and effectively delivered from the available platforms.

Variables. Findings in Mosul to date suggest a threat environment further complicated by a combination of variables: conceptual, physical, and device-specific. These influence the threat environment but do not conform to any preconceived fixed relationship determined by the design or components of the IED alone. Even then, there seem to be few constants available.¹³

For example, the environment variable may or may not cause degradation. Contrary to the argument that batteries degrade with time such that they no longer contain a charge sufficient to initiate an electrical detonator, evidence suggests in the short term this is not true. Recent tests on the batteries from a recovered RC armed PIR IED in Rawah (west Anbar) show that, despite the device being in place for approximately two years, each 9-volt DC battery in the device contained a full 9 volts of charge. Further, the battery shelf life expiry date was indicated as 2021. Evidence collected from other tests on recovered batteries provided similar data.

Constants. Given there is no clear and proven degradation of battery life as a function of time and/or environmental conditions, and therefore, the lethality of the device cannot be assumed to be reduced over time, the technical complexity of an IED is always a key factor in threat assessment, as well as a key determiner of the subsequent RSP.

Competency. Contrary to normal RSPs that usually would rely on explosive materials, conditions in Mosul call for simple tools such as “j-cutters” used semi-remotely to neutralize IEDs as well as highly-trained IEDD operators with the skills and experience to recognize and render safe threats. For example, devices such as the improvised ISIS 120 mm mortar bombs may contain high-explosive or chemical-agent (mustard gas) fills. Often only subtle details differentiate between threats, which may or may not be safe to move.

Hostility. IED operators work in high-threat environments where render-safe operations expose them to retaliatory attacks. In addition, there is always a possibility that the security situation within a clearance location can deteriorate and the IED operator becomes a target by virtue of the fact that they are clearing IEDs.



A “j-cutter” positioned prior to semi-remotely cutting a single electrical wire connecting a power source to an IED.

Characteristics. For purposes of EH clearance, west Mosul can be characterized as a complex environment based on the following factors:

1. A diverse range of complex IEDs.
2. The quantity of IED threats and other EH threats present.
3. The three-dimensional exposure.
4. Accessibility to clearance sites for threat assessment.
5. Reliance on semi-remote means for neutralization.
6. Extreme consequences of accidental initiation.

Differentiation. The complex threat environment, as with all environments, should drive the selection of personnel, equipment, and training as well as standard operating procedures (SOPs) and operational-review processes.

Experience. The implications of differentiating between simple and complex threat environments in terms of assets to perform adequate, safe, and cost-effective render-safe operations, likely focus on IED operators and their experience regardless of local or international status. Moreover, qualified personnel must be present at task locations at all times to provide oversight of threat assessment and the conduct of search and subsequent RSPs. The economic implications should be as obvious as they are inescapable: the more experienced the operator, the safer and quicker clearance will be, albeit more costly the task. While the competencies for IED operators are discussed and described in IMAS and U.N. standards, the requirements of a complex environment suggest those selected both as international technical advisors as well as local national IED operators should be carefully considered, tested, and evaluated based on demonstrated skills in line with overarching competencies described in IMAS and U.N. standards.^{14,15}

Conclusions. What are the implications for future EH clearance activities in complex urban environments? Facts and analysis support the following conclusions.

1. IED clearance activities should be considered as a function of technical complexity rather than threat assessment.
2. While the perception of threat to an IED operator from a device may decrease over time in the post-event environment, facts suggest devices remain lethal in the long term.
3. The EH context as determined by pre-event, event, and post-event phases and related factors establish a context for threat assessment and appropriate RSPs.
4. Existing HMA doctrine will need to change to reflect this new operating reality. UNMAS is currently linking the development of standard working practices—for example, linking “residential area search and clearance” to both IMAS and implementing partner SOPs based on experience gained during operations to date in both simple and complex environments.
5. The concept of complex environments, compared to the simple environments (see previous article), becomes a key aspect not only for capacity development but recruitment and selection of IEDD operators. Future work plans are now carefully tailoring implementing partner capabilities to match the operational environment.
6. The need for continued research and analysis of ongoing operations should include a lethality index based on the pre-event, event, and post-event phases and related factors identified as a gauge to assess future operations and task difficulty, also important as a basis to establish and report efficiency and cost-effectiveness.

To be continued. ©

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Mark Wilkinson, Ph.D.

Explosive Hazard Management Team Leader
United Nations Mine Action Service (Iraq)



Mark Wilkinson, Ph.D., a UNMAS (Iraq) Explosive Hazard Management team Leader, has 20 years of professional experience in military and HMA. As a former British Army Ammunition Technical Officer, he worked as a High Threat IEDD Operator in several operational environments before transitioning to HMA. His HMA experience has developed through

time spent as an IEDD operator, then a program manager, before transitioning to UNMAS. His academic background includes a master's degree in global security and a doctorate (Ph.D.) in politics and international studies. His thesis on arms control and intelligence has been published internationally as the book *Before Intelligence Failed*. He is also a Visiting Fellow at the University of Nottingham Centre for Conflict, Security and Terrorism where he maintains an active research agenda.

The Impact of Landmines and Explosive Remnants of War on Food Security: *THE LEBANESE CASE*

by Henrique Garbino [Swiss Foundation for Mine Action]

The year 2017 was the third in a row of an exceptionally high number of mine victims. According to the *Landmine and Cluster Munition Monitor*, in 2017 alone, 7,239 people became casualties of landmines or explosive remnants of war (ERW), of which at least 2,793 were killed.^{1,2} Apart from their direct physical effects, landmines and ERW also restrict access to basic resources such as food and water, limit the use of key infrastructure, and both force and restrict migration.³ This article focuses on the impact of landmines and ERW on food security, with an emphasis in food production.

Even though the relationship between landmines and food production may seem obvious, theoretically, there are many different possible mechanisms linking them, depending on the affected country or region. Thus, the aim of this article is twofold. First, it provides an overview of the possible theoretical mechanisms connecting landmines and ERW to decreased food security. Second, the theory is applied and assessed in the case of Lebanon.

The case study is presented based on specific literature on the Lebanese case, and on reports from the Lebanon Mine Action Centre (LMAC), the *Landmine and Cluster Munition Monitor*, the United Nations, and other international organizations. Whereas landmines and ERW still present a grave threat to civilians and pose a significant impediment for the development of affected communities, this article finds that landmines and ERW alone insufficiently explain food insecurity in Lebanon.

Nexus Between Landmines and Food Security

Researchers, policy-makers, and practitioners have been increasingly aware of the often-unremembered impacts of armed conflict. Previous research has focused on the environmental

damage caused by warfare and its effects on land management and migration.^{3,4} Drawing on this specific literature and other papers on landmines, cluster munitions, ERW, and improvised explosive devices (IEDs), as well as mine action reports, it can be assessed that landmines impact food security via six different and somewhat reinforcing mechanisms: access denial (to arable land, water sources, and infrastructure), loss of livestock, land degradation, reduced workforce, financial constraints, and aid dependency.

Food security is impacted by landmines via the lack of access to arable land. Minefields are basically laid either to provide protection to military bases and strategic resources or as obstacles to the enemy's freedom of movement.⁵ For the latter, it is likely that minefields will cover a large extent of otherwise unprotected areas, such as open fields and plains. Alternatively, militaries and nonstate armed groups frequently lay nuisance minefields, aimed at delaying and disorganizing the enemy.^{5,6} Therefore, large areas of arable and pasture lands are contaminated by landmines, for example, in Lebanon, Angola, Mozambique, Cambodia, Sinai, Kuwait, and Iraq.⁷ Access denial is further extended due to the suspected presence of landmines or ERW.

Landmines are also laid near water sources to reinforce natural obstacles, such as beaches, rivers, lakes, and irrigation ditches.⁸ Likewise, dams and hydroelectric power plants, often perceived as strategic targets, may be protected by minefields.⁵ The consequent lack of access to water sources further compromises food security, especially livestock, animal production, and herder communities. In addition, minefields aim to restrict access to infrastructure. Key roads, highways, railways, ports, and airports, as well as stations, bridges, and crossings are likely to be mined during conflicts. In this sense, landmines also limit the maintenance

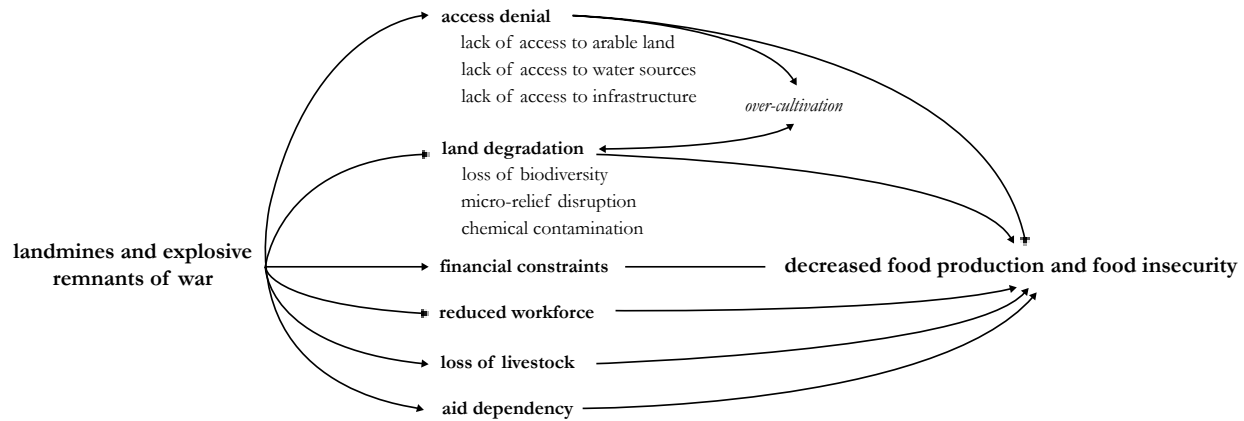


Figure 1. Summary of causal mechanisms (adapted from Berhe and GICHD).^{7,9}
All graphics courtesy of the author.

and construction of new infrastructure,^{7,9} which indirectly impacts the food production chain.

Livestock is directly affected by mines, especially large mammals such as cattle, horses, camels, and even sheep.^{10–12} Moreover, when humanitarian demining programs are absent, communities rely on rudimentary techniques to assess whether an area is safe or not. In many cases, this means letting cattle graze in suspected hazardous areas.^{7,13}

Landmines may cause land degradation in roughly four ways: through loss of biodiversity, micro-relief disruption (disruption of the first layer of soil), chemical contamination, and over-cultivation.^{7,9} First, fauna and flora are affected by the physical and chemical effects of the detonation of landmines and ERW. This is particularly relevant for conflicts fought in forests¹⁴ or on routes of migratory animals. In addition, when arable land is not accessible, communities turn to forests as their last resort for fuel (i.e., wood), food, and shelter. This effect is aggravated by the concentration of refugees and internally displaced persons, who are considerably limited by minefields and concentrate around safe areas. It must be emphasized, though, that in some mined and contaminated areas biodiversity is actually very high due to the lack of human interference (e.g. the Korean peninsula's demilitarized zone).¹⁵

Demining techniques may also contribute to loss of biodiversity and deforestation. While removing small bushes and plants is a standard process in both mechanical¹⁶ and manual mine clearance,¹⁷ some communities and demining organizations set minefields on fire in order to clear the vegetation and facilitate future work.⁷

Conversely, some authors argue that vegetation loss, micro-relief disruption, or even burning in mine clearance operations may have a positive effect in biodiversity by creating different mixes of habitats across the landscape.¹⁸ Moreover, as it relates to food production, both manual and mechanical mine clearance techniques arguably facilitate future land

use for agricultural purposes, by clearing the field and effectively ploughing it.

Likewise, micro-relief disruption is caused by the accidental detonation of landmines and ERW, the use of fire as a rudimentary demining technique,⁷ and standard demining procedures. During standard manual mine clearance, deminers are required to remove the first layers of soil not only for every landmine or ERW they find but for each metal fragment detected, including shrapnel and bullet casings. Moreover, if the condition of the mines or ERW do not allow for their removal and further destruction in a specific area, those are exploded in situ and increase soil damage.¹⁸

Albeit minimally, land degradation may be caused by chemical contamination. Regardless of whether their explosive contents have detonated or not, landmines and ERW contaminate the soil and water sources with toxic substances,¹⁹ including heavy metals¹⁹ and depleted uranium,⁷ which come from either the ammunition casings or their explosive contents.¹¹

It is worth noting that there is little evidence of actual chemical contamination from conventional mines. There are a few landmines which might use liquid explosives (e.g. PFM-1) that have toxic effects. However, given their small size, the resultant contamination is most likely negligible. The majority of mines are constructed from TNT- and RDX-based explosives, which are largely organic compounds and result in little or no toxic effects.

Notably, the arable lands not contaminated by landmines usually suffer from over-cultivation. First, a smaller portion of land is pressed to produce more to compensate for the contaminated areas.⁷ Second, these areas are often occupied by forcibly displaced persons, who perceive the settlement as temporary and do not invest in sustainable land management.²⁰ In the long term, these practices may lead to soil exhaustion and decreased food production.

Landmines also contribute to a reduced rural workforce by killing, maiming, or injuring thousands of civilians every

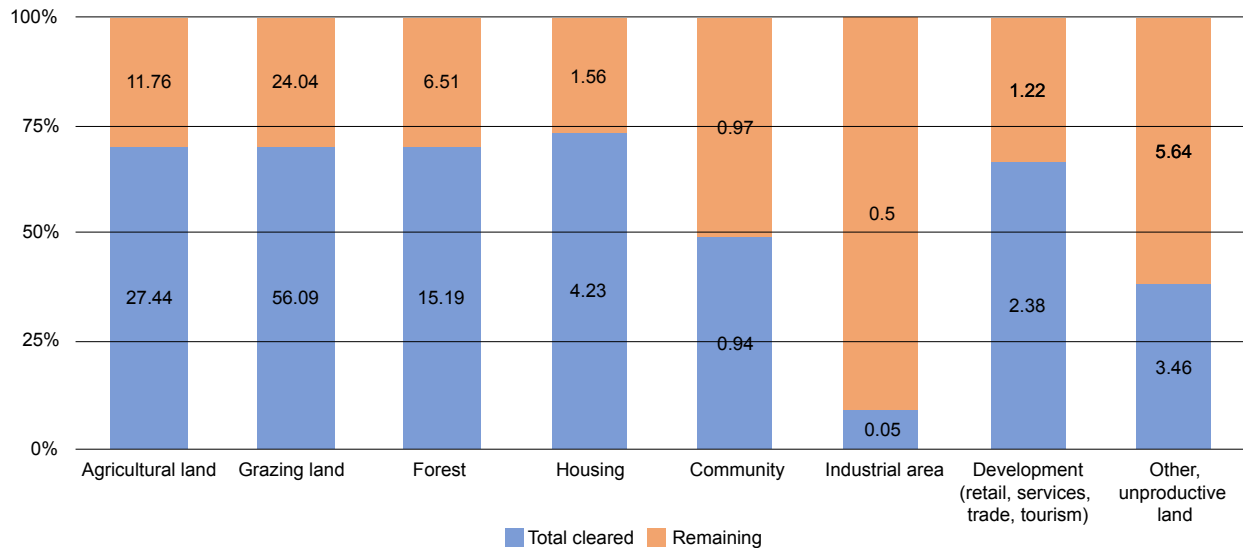


Figure 2. Estimation of contaminated land distribution in square kilometers (as of 2017).³⁰

year. Mostly men and boys, who are usually the ones responsible for providing for the household, fall victim to landmines and ERW.¹⁰

Finally, mine action entails considerable costs to the affected state, posing as a financial burden to investments in development. The already fragile economies of affected countries are further weighed down by the enormous costs of mine clearance and victim assistance.^{7,9} Therefore, international support is critical for sustaining mine action programs. However, when badly managed, food assistance may undermine local production and cause aid dependency.^{22,23}

Case Study: Lebanon

Lebanon is mostly contaminated with landmines and ERW from its two most recent conflicts: the Lebanese Civil War (1975–1990) and the 2006 Israel-Hezbollah Conflict, as well as minor clashes with Israeli forces from the 1990s to the 2000s.^{24,25} A survey conducted in 2003 estimated that a total surface of 279.4 sq km was suspected to be contaminated with landmines from the civil war.²⁵ The last contamination occurred during the Israeli bombings from July to August 2006, when an additional 54.9 sq km were contaminated with approximately one-million cluster munitions that did not detonate.^{26,27} In northeast Lebanon, spillovers from the current conflict in neighboring Syria has also led to new contamination of mostly IEDs, booby-traps, and unexploded ordnance (UXO).²⁸

It is estimated that landmine and ERW contamination in Lebanon after the 2006 invasion reached a peak of about 334 sq km, more than 3.2 percent of the country area.²⁶ The most affected areas by landmines are in Batroun, Chouf, Jbeil, and Jezzine, north of the Litani river, in the Bekaa Valley, and across Mount Lebanon, as well as the Blue Line,

the U.N.-demarcated border with Israel.²⁴ Cluster munition contamination is concentrated in southern Lebanon, south of the Litani river.²⁹ A recent study commissioned by the United Nations Development Fund and LMAC further estimated the distribution of the contaminated area according to their use (Figure 2).³⁰

Even though most of the affected areas are comprised of agricultural and grazing lands, those areas were defined by the Lebanon Mine Action Authority as second priority, and the clearance processes began only in 2009. The first-priority areas include access roads, infrastructure, water, electricity, municipalities, schools, houses, and gardens; while the third priority consists of uncultivated land, natural reserves, and wildlife territories.

Socioeconomic development has been considerably affected, especially by ERW contamination. Almost 40 percent of land used for livelihood has been contaminated and, out of the total area contaminated with cluster munitions, 97 percent is used for food production (78 percent for crop cultivation and 19 percent for livestock).²⁹ Apart from major losses in the 2006 harvest season, unexploded cluster munitions rendered a large swath of southern Lebanon inaccessible to the local population.^{31,32} LMAC estimated that the cost of lost agricultural production in 2007 amounted to US\$126.7 million. Due to the mine action program, this value dropped to \$25 million in 2011.²⁴ Darwish et al., however, argue that estimates of economic losses in southern Lebanon usually fail to account for indirect costs, which could amount to four times the initial estimates.^{33,34}

Post-conflict reconstruction and rehabilitation, as well as development of infrastructure, were considerably hindered by landmines and ERW in southern Lebanon.^{35,36} Preliminary estimates of the damaged caused by the 2006

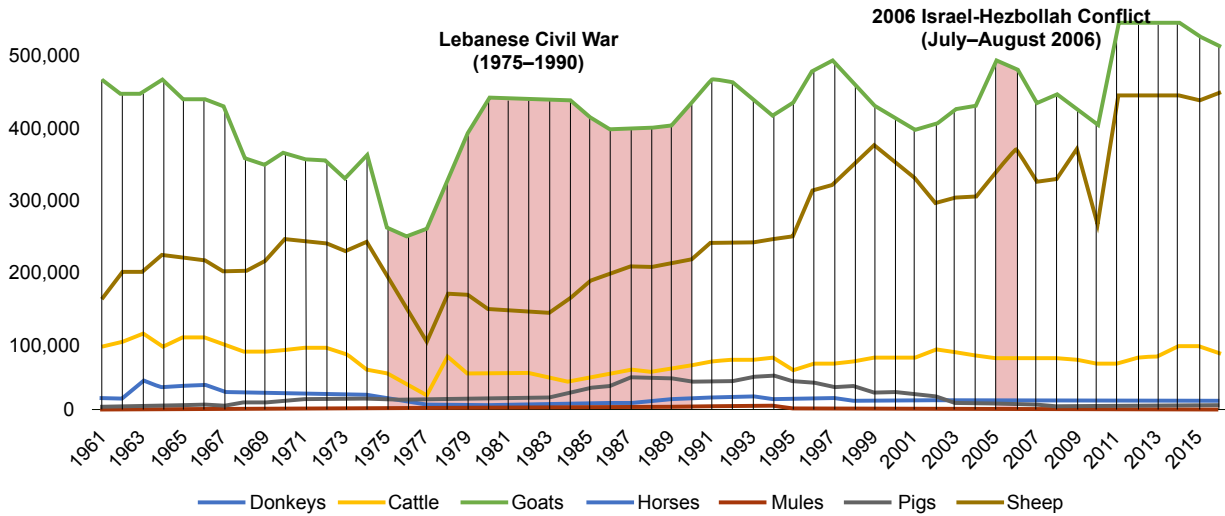


Figure 3. Number of livestock in Lebanon 1961–2016).

war accounted for more than 340 infrastructure locations and sections of road rendered inaccessible.³⁷ Accordingly, infrastructure was prioritized by the national mine action strategy for land release and was completely cleared between 2006 and 2009.^{24,38}

There is not much research on the impacts of landmines and ERW on land degradation in Lebanon. In terms of biodiversity, however, natural reserves and wildlife territories were defined as third priority and have only recently been targeted by mine action programs.^{30,37} In addition, landmines are known to have impacted the management of cedar forests, in particular the Tannourine Cedar Forest Nature Reserve.³⁹

Mine clearance also contributes to the loss of biodiversity and micro-relief disruption in Lebanon. Mined areas are burned prior to demining in order to remove vegetation and facilitate mine clearance operations. This practice has been employed since at least the 1990s⁴⁰ and has become a standardized

practice, as provided for in the National Mine Action Standards (NMAS).⁴² In accordance with regular manual demining techniques, ground vegetation is removed during mine clearance operations. However, the NMAS do not specify the maximum branch diameter to be cut and removed,⁴⁰ leaving it to the discretion of demining organizations. Moreover, the default disposal procedure for landmines and ERW is destruction in situ. This means that wherever found, landmines and ERW shall be destroyed, except if it proves to be impractical or poses considerable risk to nearby structures.⁴⁰

Literature is mostly absent in addressing soil and water contamination due to landmines and ERW in Lebanon. Nonetheless, there is strong evidence of depleted uranium contamination from Israeli bombings in 2006.⁴² This contamination is likely to come from bunker busting bombs and missiles, which are less likely to fail and become ERW. Moreover, other general studies on soil contamination in

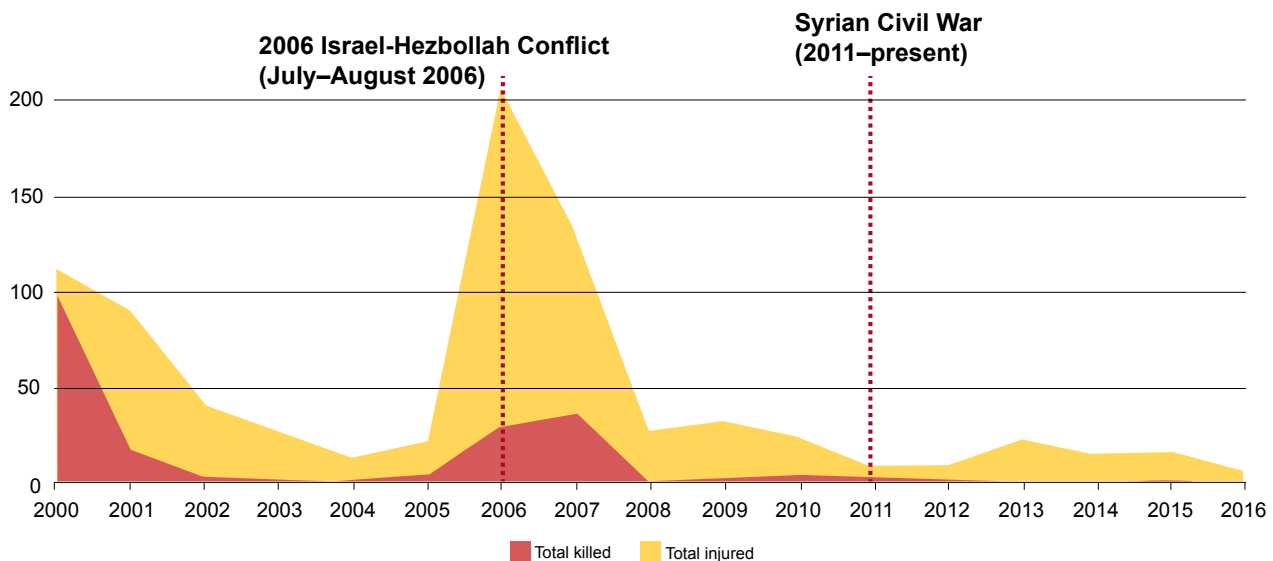


Figure 4. Total landmine and ERW casualties (2000–2016).

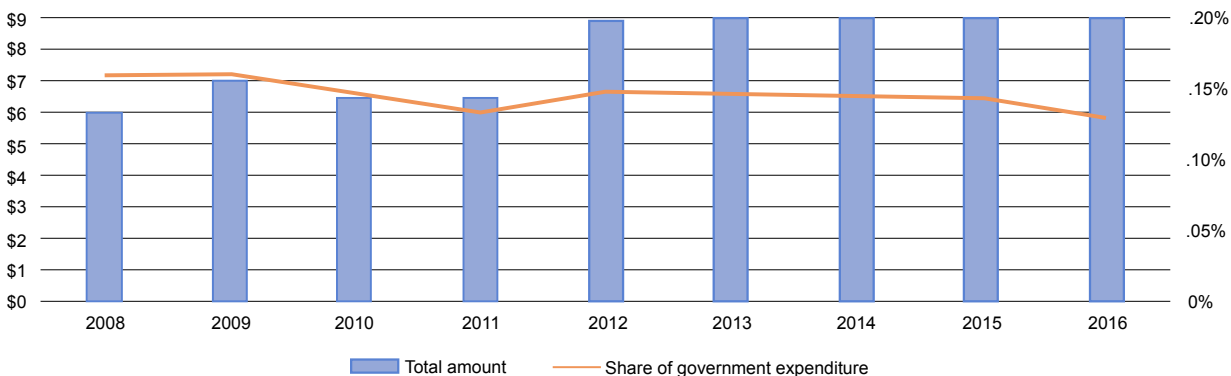


Figure 5. National investment in mine action, in million US dollars and as share of total government expenditure.

Lebanon do not consider landmines and ERW but focus on other sources of pollution.⁴³

Loss of livestock is not accounted for in national or international mine action reports,^{44,45} as it does not seem to present a grave problem in Lebanon. Accordingly, data from the Food and Agriculture Organization (FAO)⁴⁶ suggests that livestock production is more conditioned to the conflict itself and area access than the physical effects of landmines and ERW (Figure 3).

As of the end of 2016, at least 3,736 people were involved in accidents with landmines or ERW, of which 906 were killed and 2,830 injured.⁴⁷ Even though the data available on casualties is highly inconsistent, most sources indicate that victims are largely men and boys—accounting for roughly 90 percent of all casualties—from rural communities.⁴⁸ After the Israeli invasion in 2006, casualties were concentrated in southern Lebanon; however, due to the influx of Syrian refugees since 2011, victims are now concentrated in the northern and eastern regions.⁴⁷ Accordingly, data made available in reports from the *Landmine and Cluster Munition Monitor* and LMAC^{25,43,46,49-61} show a sharp increase in casualties after 2006 and a smaller increase after 2011 (Figure 4). The graph also suggests the beneficial outcomes of mine clearance and mine risk

education (MRE), since casualties tend to decrease in time.

By design, most mine-related incidents do not cause death. Likewise, the desired effect of cluster munitions is achieved by their detonation in large quantities; individually, one munition is usually not sufficient to kill a person. Accordingly, Youssef and Jawad Fares have found that most casualties in Lebanon suffered amputations and injuries in craniofacial regions, thorax, abdomen, and lower and upper extremities.⁶² Those injuries led to loss of motor function, body disfiguration, chronic pain, and post-traumatic stress disorder.⁶⁰

The Government of Lebanon, as indicated in Figures 5, 6, and 7,^{44,63} has invested \$7.88 million per year on average in mine action for the last ten years, or roughly 13 percent of total government expenditure (Figure 5). In comparison to international mine action funding, even though more modest on average, national investments are more stable (Figure 6). Moreover, the national share of mine action funding has considerably increased since 2008 (Figure 7).

Even though Lebanon is a considerably well-structured and functioning state, information on landmines and ERW is often inconsistent, missing key observations, and scattered across various sources, perhaps due to the recent establishment of the national authority and coordination center.⁶⁴

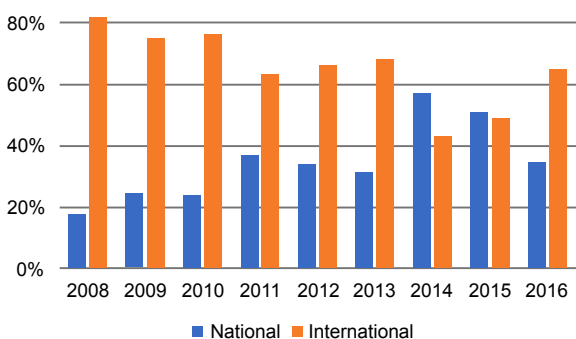


Figure 6. National and international investment in mine action, in million US dollars.

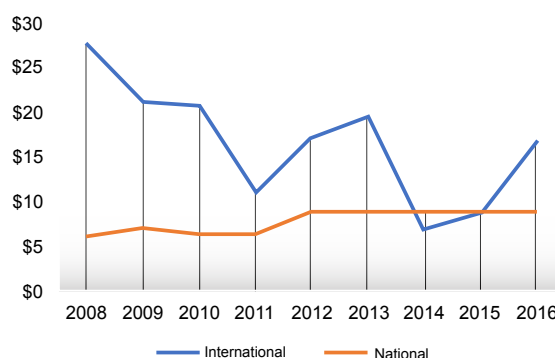


Figure 7. Share of total investments in mine action.

Discussion

As previously discussed, Lebanon has been significantly affected by the scourge of landmines and ERW. Contaminated areas have denied access to large swaths of arable land, especially in southern Lebanon, and, to a lesser extent, to water sources and infrastructure. According to LMAC, all water sources and infrastructure are deemed to be clear from mines and ERW. Indirect losses in productivity due to lack of access to arable land and pasture may amount to about \$30–\$60 million, during an estimated ten-year period for clearing the affected areas.³³

Victims of landmine and ERW accidents undoubtedly suffer tremendous personal challenges. However, the total number of casualties is likely too small to impact food production and food security outside the victim's closest circles. It is worth noting that the number of casualties has considerably dropped in recent years, probably due to the ongoing MRE and mine clearance activities.⁴⁴ That said, food security is perhaps more affected by the displacement of rural workers toward urban environments as a consequence of lack of access to arable land and fear of the threat of landmines than by the direct effect of landmines in killing or maiming civilians.

The recent influx of Syrian refugees coupled with the existing mine and ERW threat pose yet another risk to food security in Lebanon. Refugees are concentrated in mostly mine- and ERW-free areas in the Bekaa Valley,²⁹ which is also the region with the most productive agriculture and livestock in Lebanon. In 2015, an estimated 3.3 million people, including Syrian and Palestinian refugees and host communities, were in need in the country; of which 1.35 million were in need of food.⁶⁵ Food aid is mainly provided by the World Food Programme and its partners, mostly through e-cards, cash, and food vouchers.⁶⁵ These measures help foster local economy and build local capacities, avoiding aid dependency. However, as proposed by Berhe⁷ and in reference to Hardin's tragedy of commons,²¹ it is likely that the concentration of refugees in small areas will lead to over-cultivation and soil exhaustion in the long run unless accompanied by efficient water and land management.

Despite considerable international financial support, the Government of Lebanon bears significant costs for its mine action program. In the last years, almost .15 percent of government expenditure have been dedicated to mine and ERW clearance, MRE, victim assistance, and other support and administrative costs. Nearly all the investment goes to mine clearance, which is the most expensive component of mine action. In 2016, for example, about 93 percent of total investments was dedicated to the clearance of landmines and ERW.⁴⁴

The financial burden born by the Government of Lebanon is an impediment for investment in other areas, such as infrastructure, agriculture, and water and land management. On the other hand, the Lebanese mine action program is consistently becoming less reliant on international support, thus decreasing its risk of aid dependency.

Conclusion

Access denial, especially to arable land and pasture, and the financial burden born by the government seem to be the most pressing challenges to food production in Lebanon. Lack of access is not only the main cause of insufficient agricultural productivity, but it is also responsible for channeling the movement of Syrian refugees and restricting settlements. Even though there is not enough information on land degradation in relation to landmine and ERW contamination, it is best contained with effective water and soil management techniques and programs. The economic costs posed by the mine action program, however, consist of a significant share of government expenditure and arguably presents an impediment to investments in other areas.

However tragic, the reduction of rural workforce due to mine- and ERW-related incidents does not seem to be sufficient to impact large-scale food production and food security. Mine victims and their families certainly face huge challenges to rehabilitation and personal development, but this impact is likely to be restricted. Likewise, the loss of livestock does not appear to be a significant concern.

Finally, there may be significant information gaps and measurement errors in the data on mine action in Lebanon. On top of that, the psychological impact and trauma caused by death and injury of loved ones, being unable to provide for your family, the loss of livelihood activities, and the constant fear of landmines, are harder to measure.³⁴ However, they certainly have profound effects on the economic, social, and psychological well-being of local communities. ©

See endnotes page 61

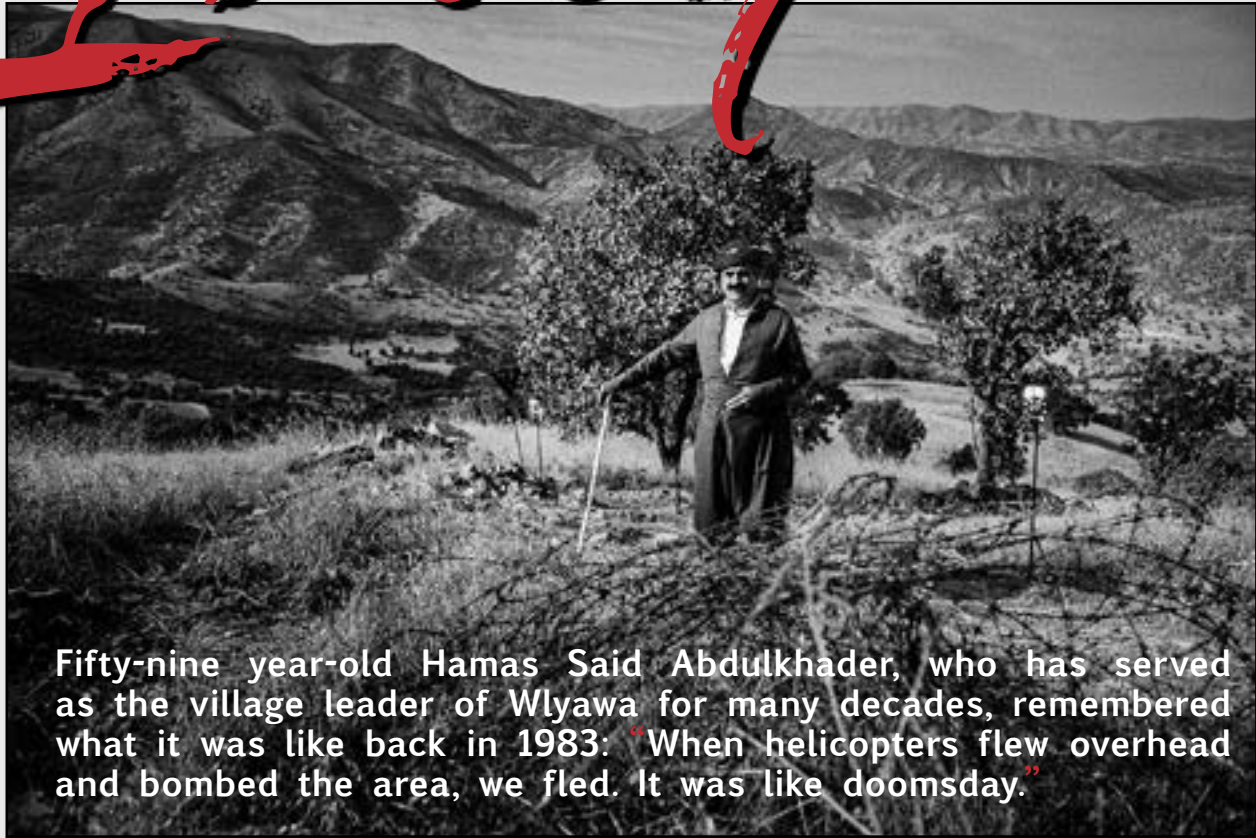
Henrique Siniciato Terra Garbino
Swiss Foundation for Mine Action
Uppsala University, Department of Peace and Conflict Research



Henrique Garbino served in the Brazilian Army from 2006 to 2017 as a combat engineer officer and an EOD specialist. He has recently finished the master's program at Uppsala University Department of Peace and Conflict Research and, as part of the Rotary Peace Fellowship, he was posted for three months to FSD programs in Tajikistan and Ukraine.

Iraq

A photo essay by Sean Sutton
[MAG, Mines Advisory Group]



Fifty-nine year-old Hamas Said Abdulkhader, who has served as the village leader of Wlyawa for many decades, remembered what it was like back in 1983: "When helicopters flew overhead and bombed the area, we fled. It was like doomsday."

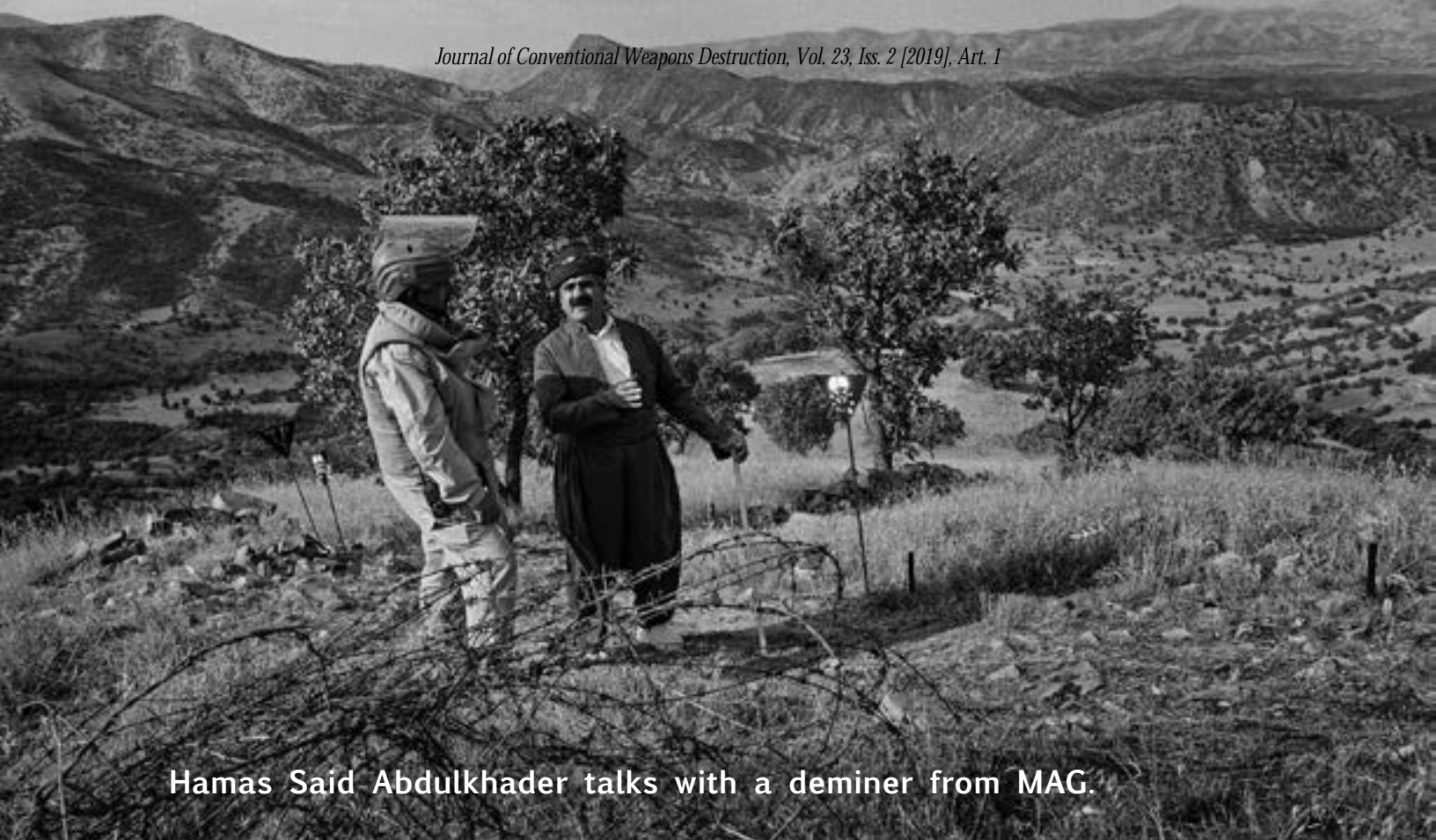
MAG (Mines Advisory Group) has worked in Iraq since 1992 to make land safe for populations affected by decades of conflict. Landmines, cluster munitions, other unexploded bombs, as well as new contamination from the recent conflict with ISIS, have left a deadly legacy that prevents communities from using their land, and displaced populations from returning home safely.

This historic contamination has been compounded by new contamination from the recent conflict with ISIS since 2014. Over 3.4 million people were displaced at the height of the crisis and the fighting has seen large areas of Iraq contaminated with landmines of an improvised nature, manufactured on an industrial scale, and deployed in urban, village, and rural settings.

The situation has led to numerous accidents among returning populations and continues to prevent many others from returning to their homes, placing a strain on resources in other areas of the country.¹

Landmines and Unexploded Bombs Destroyed	Land Released by Deminers, Dogs, and Machines	Direct Beneficiaries	Risk Education Sessions
9,648	6,334,116 sqm	397,134	18,219

Results of MAG's work in Iraq in 2018.
All graphics and images courtesy of Sean Sutton/MAG.



Hamas Said Abdulkhader talks with a deminer from MAG.

Wlyawa Village

Wlyawa is a small village in the Sharbazher district of Sulaymaniyah Governorate. Currently, seven families, consisting of around 50 individuals, live in the village. However, before the Iran–Iraq war, around 250 people from 25 different families called this village home. The village used to be productive and thriving until people were forced to flee the area in 1983. The Iraqi army had set up military positions for their fight against Iranian troops who were based in the next village, situated only 15 kilometers away.

Fifty-nine year-old Hamas Said Abdulkhader, who has served as the village leader of Wlyawa for many decades, remembered what it was like back in 1983: **“When helicopters flew overhead and bombed the area we fled, it was like doomsday.”** At that time, the Iraqi army controlled the main towns and roads, but most villages were controlled by the Kurdish Peshmerga, and some areas were controlled by Iran. **“We fled from village to village, eight times in total. Eight times my house was destroyed. Thinking about that time still brings tears to my eyes. My ancestral homeland, where my grandfather came from, was gone, destroyed. I’m still so sad about it.”**

After the Kurdish uprising of 1991, the Iraqi army left the area. Subsequently, 20 families returned and tried to rebuild the village, however, the presence of landmines made this impossible. Hamas said, **“The first accident was in 1983, when, after we had fled, one man went back to the**

village to get some things from his house. He was killed by a mine. That’s how we found out there was a problem.”

In December 1991, a man from the village lost a leg to a mine. Tragically, just ten days later, Hamas’ brother was killed. **“HE WENT UP A HILL TO SEE WHAT WAS LEFT OF THE ORCHARD AND ON HIS WAY BACK HE STEPPED ON A MINE.”**

Between 1993 and 1994, there were two more accidents where villagers lost a leg. A year later, two children—seven-year-old Ako and nine-year-old Awat—came upon a mine and were both killed. Each year, the village lost about 50 animals: dogs, sheep, cows, and goats.

“There were mines to the north, east, south, and west of us, only 20 meters away from where we lived,” Hamas continued. **“Seven families stayed, the other thirteen left.”**

MAG began clearance in Wlyawa in 1996. One team worked in the village for two years and cleared prioritized land close to the houses, on both sides of the road, and one of the minefields going up the hill. More than 200 landmines were removed from the village. Due to the scale of contamination in the area and the limited availability of resources, the team then moved on to work in other villages. In 2016, MAG returned to the village and continued to carry out clearance of the remaining minefields around the village. In the past year alone (October 2017–September 2018), 59,354 m² of land was released and returned to the community. During the clearance activities,

a total of 354 dangerous items were found and safely removed from the land, including 229 anti-personal mines and 125 items of unexploded ordnance (grenades, mortars, rockets, and projectiles).

The Sharbazher district is known for agriculture, especially its vineyards. Before the war, Wlyawa produced tobacco, dried grapes, pears, peaches, plums, and figs. One specialty of the village was growing acorns, which can be crushed and used to feed animals. The village sold more than 200 tons of acorns every year. Even today, agriculture is the main source of livelihood for the remaining villagers in Wlyawa. They produce raisins, jam, and candy with grape paste and almonds or walnuts.

The villagers also grow a fruit called medlar, and sumac, a flavoring spice that is widely used in the Middle East. There are gumtrees in the area, from which the gum is sold for medicinal purposes and for producing chewing gum. MAG's clearance teams are currently working on Wlyawa's agricultural land.

Hamas explained the significance of this land for his village: **“The land that is not being cleared by MAG includes the best orchard and the best vineyard in the area. It also has a spring that is very important for the village. The area is about five hectares and is perfect for agriculture. We can use a tractor on the land, and the ground is very fertile. The people who moved to the city because of all the mines have grown tired there. The economy is very bad, they want to come back home. In the past, we used to export products to southern Iraq and Iran. Now, we have to import goods to survive.**

The mines are further from the village, so thankfully the danger is less than it was before. But still the community is denied access to some of their most fertile land. Yet, our future looks brighter because of MAG's work. When we gain access to all our land again, I expect many people to return. This land is rich.”

In March this year, MAG deminers found a watch in a minefield, at a spot close to where a mine had detonated. The supervisor working at the site knew Hamas and that his brother had been killed in the area, so called him. I asked him if it was a rectangular Orient watch, and he said



An EOD team deals with a cache of projectiles reported to MAG by a farmer.



A few of the items could be seen on the surface and when the team investigated they discovered many more underneath.



A total of 28 mortars and projectiles were found, removed, and later destroyed in a controlled demolition.



Hamas Said Abdulkhader with his brother's watch.

that it was," Hamas said. **"I felt my brother's spirit. I was both sad and happy at the same time. I lost my brother, but now I have gained many new brothers, the MAG staff. That's how I feel. Yes, I lost one brother but have gained many more. This watch, I had bought this watch in 1988. My brother said it was a beautiful watch, and so I took it off and gave it to him. THE WATCH STOPPED AT TWENTY MINUTES PAST TWO IN THE AFTERNOON, WHICH WAS THE MOMENT MY BROTHER WAS KILLED."** Hamas paused for a moment before continuing, **"The village will return to the way it used to be. We can rebuild it. We just need the land to be safe. Saddam's army is still here. They are a strong army, they don't run away from the snow, and no one can see them, but they are still here. But MAG will save us. Life is hard in Sulaymaniyah city for our people who have not yet returned. Many don't have jobs, and this is their home, this is their land. But they need safety."**

MAG has deployed several teams in and around Wlyawa village. There are many minefields that remain, and several decades after these mines were laid, they continue to have a devastating effect on the population of the village. Hamas' story and what Wlyawa has experienced is all too common among villages in the area, highlighting the ongoing need for clearance of remaining legacy minefields. When cleared, the people from Wlyawa and other villages can finally leave the war behind them and rebuild their communities fully, free from fear and danger.

Meshulan Village

Namiq Aziz has six children and two wives. He and his family live in the middle of a minefield. They are the only family living here but many others would like to return to their village and their ancestral land. The location of the village is stunningly beautiful in the middle of rolling hills. The fertile area is famous for many kinds of crops.

There are landmines all around their farm and the cost has been high. Namiq's mother lost a leg to a mine that had rolled down the hill and landed near the front door. His cousin Karsan lost his eyes and his arms in a landmine explosion and Karsan's son Jamal was killed just behind their house.

This area is heavily mined, denying fertile land to many communities.



“The first accident was with my cousin called Jamal. He died 100 meters away from our house in 1992.”

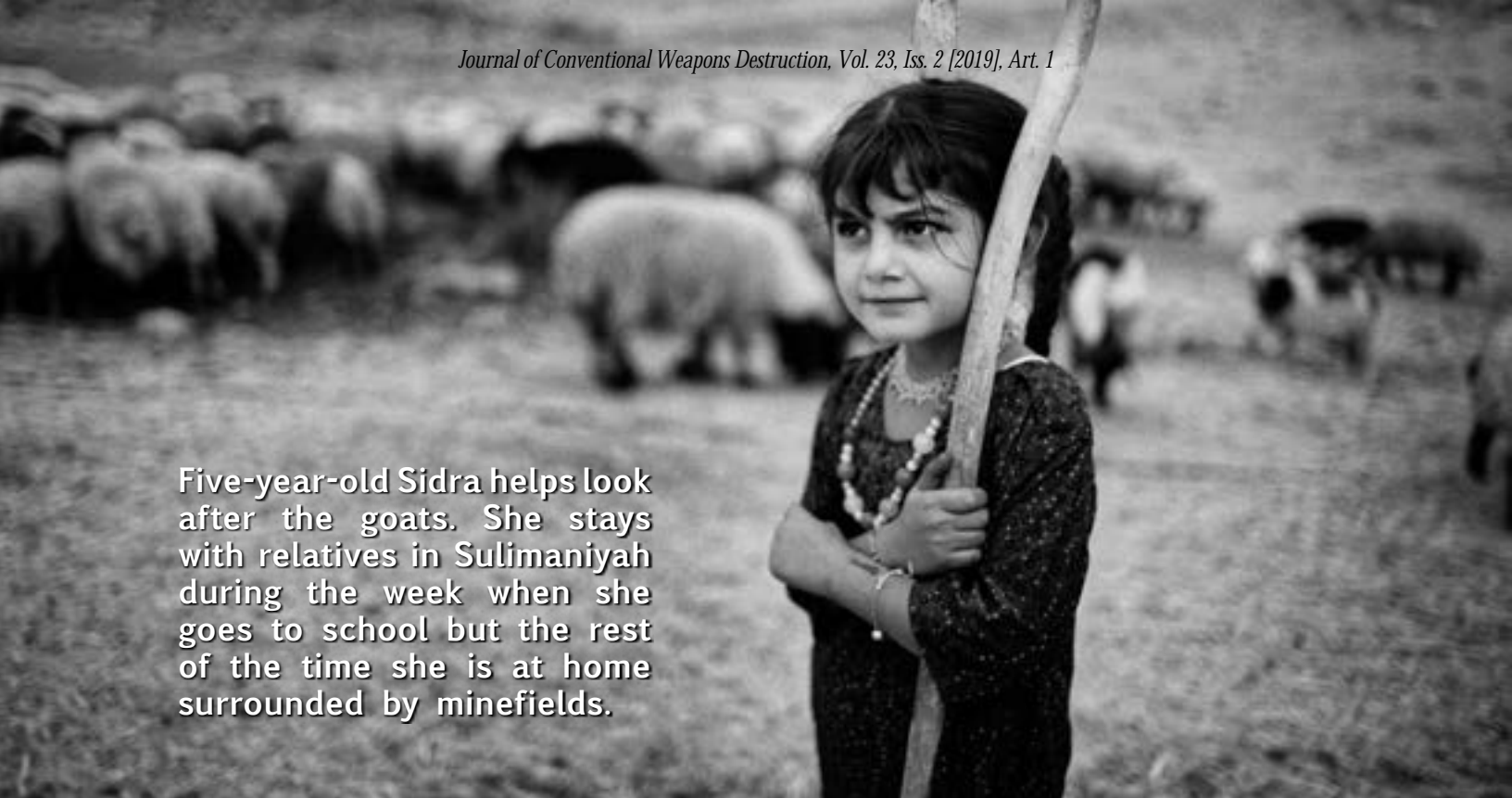
“Then in 1994 my mother stood on a mine by the front door and her leg was blown off. The mine had rolled down the hill.”

“Then my cousin, Jamal’s son Karzan ... set off a mine and was blinded. He also lost an arm. This was in 2000.”

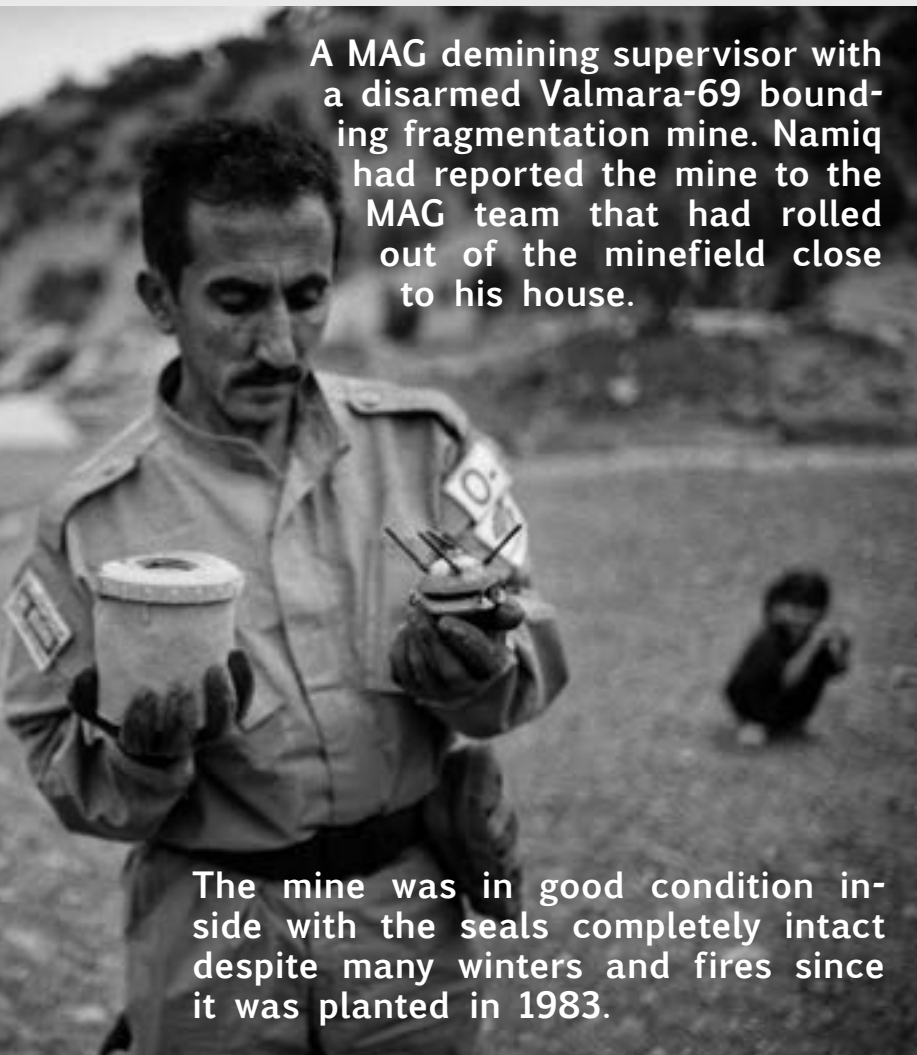
“There were 15 families living here before. They were good times and we lived well. There is good pasture land for livestock and also perfect land for agriculture. We grew tomatoes, tobacco, watermelons, and lots more and sold a lot of produce. The village was famous for good eggs and people used to come from other villages to get eggs. Turkeys have also been very special here—every house had many of them. We feed them a special diet. Honey, the honey is very special—we used to sell a lot. **IT WAS GOOD UNTIL THE WAR STARTED ...**”

Namiq was also injured—he cleared dozens of VS50 landmines to make a safe path through one of the minefields so that his sheep could reach a good pasture.

Some detonators from the mines he had in a bag exploded and he lost some of his fingers.



Five-year-old Sidra helps look after the goats. She stays with relatives in Sulimaniyah during the week when she goes to school but the rest of the time she is at home surrounded by minefields.



A MAG demining supervisor with a disarmed Valmara-69 bounding fragmentation mine. Namiq had reported the mine to the MAG team that had rolled out of the minefield close to his house.

The mine was in good condition inside with the seals completely intact despite many winters and fires since it was planted in 1983.

The Iranians attacked the area and there were a lot of air strikes. We fled on our feet with nothing—we left everything behind. There was 150 of us with babies and elderly people and we went to a camp near Kanraw. We stayed there for a year and then went to Suaymaniya where I worked as a laborer. It was hard, we faced difficult times. We couldn't come back home until 1992 because fighting continued. After the war with Iran there was war between [the] Iraqi army and the Peshmerga.

I was amazed at what I saw when I came back. There was a burnt truck and many bodies. Everything was burnt and destroyed—even the land and the trees were burnt. There was barbed wire all around and lots of ammunition on the ground. We knew there might be landmines. Wherever military had been there might be landmines.

I was so happy to go home but so sad to see it all destroyed. About 15 families came back but few stayed. As soon as they saw the village they turned around. It was mined. Now we know where the mines are and we do our best to avoid them but every year we still lose many sheep and goats and I am always worried about the children. Now there are more than 30 families that would like to come home. We need to clear the mines, then our village will come back to life.”

-Namiq Aziz

Goran Salaadin, 28 Dog Handler

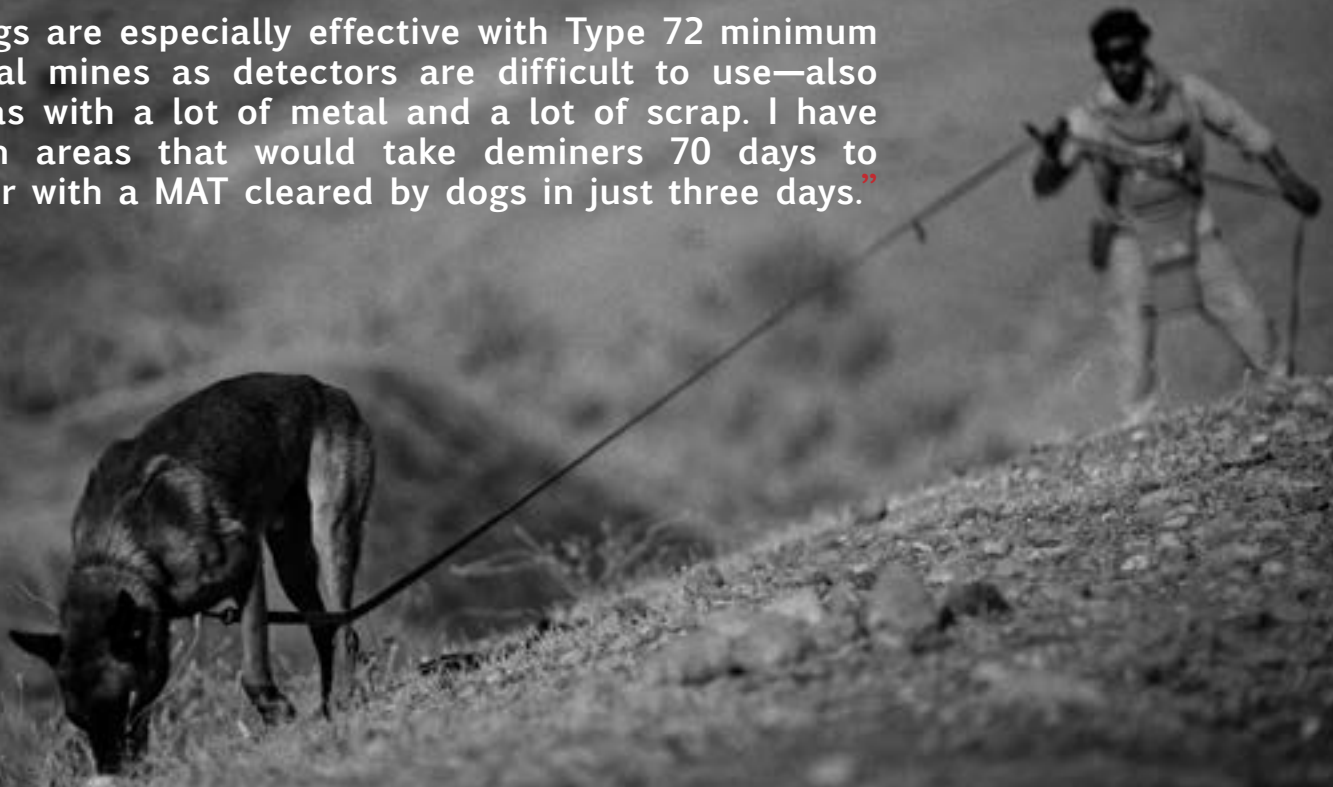


“Quewe and I have been together for four years. She is demanding and works hard but needs to rest well when she is tired. She doesn’t really like people, except for me. We understand each other very well. She tries to bite people when tired and she easily gets jealous.”

“I started working for MAG as a deminer 10 years ago. In the first two years, I found more than 100 landmines. Then I was given the chance to become a dog handler and I realized this was a great opportunity. Some people think dogs are dirty animals but I love my dog. My first dog was called Harri but he got old and was retired. He is very happy now and lives with a family. Quewe doesn’t really like people, except for me. We understand each other very well. She is getting older and will retire next year. I will bring her home to stay with my family. I have three children and she will have to get used to them. I will teach her and it will be fine.”

-Goran Salaadin

“Dogs are especially effective with Type 72 minimum metal mines as detectors are difficult to use—also areas with a lot of metal and a lot of scrap. I have seen areas that would take deminers 70 days to clear with a MAT cleared by dogs in just three days.”



Karim Mohammad, Zewe Village



“I joined the Peshmerga when I was 15. There was a lot of fighting and I fought in many places. I was injured twice, once shot in the stomach and once burnt by chemical weapons. A plane dropped them and I was blinded. Many people died. That was in 1987.

The village was on the other side of the hill before but that area is completely mined and we can't go there. The first landmine accident was in 1996 when my cousins Bakr and Sadiq were injured clearing mines. Bakr lost his leg and Sadiq lost his hands and an eye. Also, that year five of my children had an accident. They found a mine and did something to it and Saman, 6, Rezgar, 10, and Chro who was 5 died and two survived. The next one was my uncle, Amad Rahman—he was killed. His son was also killed here just few weeks ago when he set off a Valmara.

THEN I LOST TWO CHILDREN SARWAR, 9, AND SURUCH, 4, WHO WERE LOOKING AFTER SHEEP. My older brother Mahmud was shepherding a few years later. He sat down to rest. After a while he moved and somehow set off a mine. He was also killed. All of them were killed by Valmaras.

I was forced to do demining myself, I had no choice. I was going to lose all of my family. I was never scared

of demining—I just had to do it. In one hill I cleared and disarmed tree sacks full; about 300 kilos!

You can see where Valmaras are usually but the small ones (VS50s) are often under the ground about 30 cm apart. The Valmaras were usually 1.5 meters apart. I would find a row and follow them using a hoe to scrape the ground. My cousins died doing this but they didn't know what they were doing and they shouldn't have done that. So, they died.

My family have been living in a lot of fear—not a little, a lot. Too much.

Most of the land here is dangerous. Most of my family don't live here anymore. They can't. If the land was safe they would be back immediately.

They are safe where they are—but they are miserable. They do bad jobs and live a hard life. Here they could build a house and have cows and sheep. This is our land and they would be happy if they could be here.

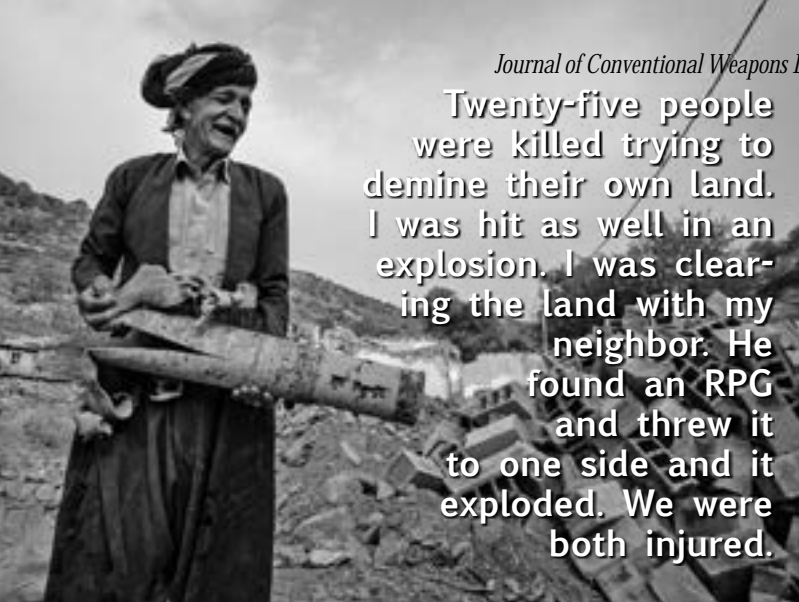
We used to grow thyme, tobacco, barley, rice, wheat, and there were orchards and vineyards. There are lots of trees here—almonds, hawthorn, and more. The people are poor. They have lost their arms and their legs. **WE NEED TO BE FREE FROM THESE LANDMINES.** We are not free—we cannot go anywhere. We live in fear, we have no safety.”



Karim walks past unexploded ordnance next to the spot where three of his children were killed.



“My family have been living in a lot of fear—not a little, a lot. Too much.”



Twenty-five people were killed trying to demine their own land. I was hit as well in an explosion. I was clearing the land with my neighbor. He found an RPG and threw it to one side and it exploded. We were both injured.

Wlaghlu Village

“Wlaghlu village is the biggest village in Sharbazar and has suffered more than any from landmines. In the 1970s there were about 150 families living there. It was a major center of trade between Iraq and Iran and had a big market—it has always been very strategic. The area is very mountainous and was the center of the uprising because it was hard for the Iraqi army to get up here. This was the base of the revolution. Because of this the area was very affected by the war. A lot of landmines, bombs, and chemical weapons were used here.

There was also a lot of fighting between Iran and Iraq. This was a main frontline area for a long time from 1980 to 1988. In the Iran and Iraq war, most of the bombs landed here. So this was the center of the two wars from 1976 to 1988. 1988 was the beginning of Anfal. The area was evacuated. Saddam’s army moved all the people to collective towns. One-thousand five-hundred were killed or never seen again in just one night.

After the no-fly zone and establishment of the green line people started to come home in 1992. NGOs helped a lot with water, shelter, and food but there were problems. **AS SOON AS PEOPLE STARTED TO REBUILD THEIR HOUSES THEY STARTED DYING.** Many were killed by UXO. When they tried to farm, they died. Every day about 10 or 12 people died in the area. People brought their livestock and they died too. Many animals were lost.

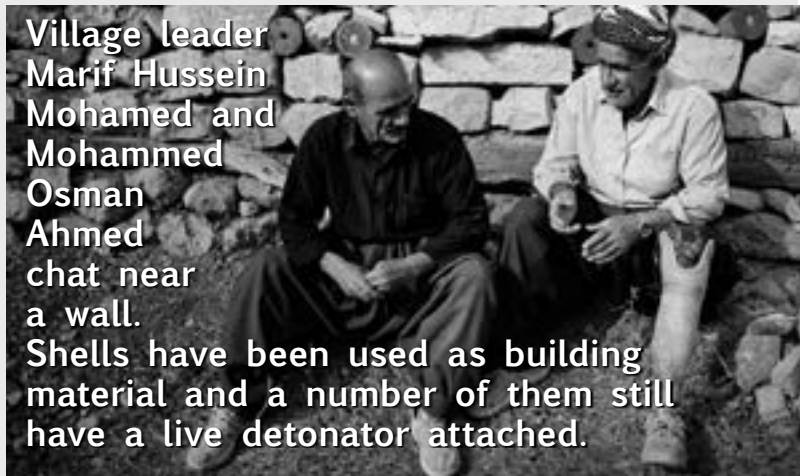
Eighteen villages in subdistricts and about 40 percent of the land is mined. There are two villages where no one has returned because of landmines, but people are starting to go back now. Qulajakh village on the other hand is still completely abandoned, destroyed and full of mines.

THE PEOPLE IN THIS DISTRICT ARE LIVING IN A CAGE. A cage made of landmines. Saddam systematically destroyed and mined the villages. The hills and countryside were already mined.

Now most of the people originally from here are having a difficult life. They know now where the landmines are—but the animals don’t. The animals go into the minefield and the children go to get them out and then they die. This is a hard life.

In the last 10 years a lot has changed here. Many people have built houses next to the minefields. There isn’t anywhere else for them [to go.] We need the donors to support the mine clearance here. We have fertile land and all we want is to return to how life was here in the 70s. We need our land. The area is very famous—it was the bread basket for the region. Clearance of the minefields will have far-reaching benefits for the population near and far. An American company wanted to build a dairy factory because this is a perfect area for cows. We have always had cows here. But they couldn’t do it because we don’t have enough land to have more cows. We produce enough goods in the area to just feed ourselves. But we should be trading. If we could trade we can develop and we can prosper.” ©

See endnote page 62



Village leader Marif Hussein Mohamed and Mohammed Osman Ahmed chat near a wall.

Shells have been used as building material and a number of them still have a live detonator attached.

Sean Sutton
International Communications Manager
MAG, Mines Advisory Group
Instagram @seansuttonphoto



Sean Sutton is an award-winning photo-journalist; his well-known pictures show the impact of landmines and explosive remnants of war on communities and have been published and exhibited all over the world. His book documenting how unexploded ordnance affect people in Laos was runner-up for the Leica European Publisher’s Award. Sutton is MAG’s international communications manager and has worked for the organization since 1997.

AMMUNITION STOCKPILE MANAGEMENT:

A GLOBAL CHALLENGE REQUIRING GLOBAL RESPONSES

by Nora Allgaier [United Nations Office for Disarmament Affairs] and
Samuel Paunila [Ammunition Management Advisory Team]



U.N. SaferGuard regional technical workshop on ammunition management in Lima, Peru, July 2018.
Image courtesy of UNLIREC.

Aging, unstable, and excess conventional ammunition stockpiles pose the dual risk of accidental explosions at munition sites and diversion to illicit markets, thereby constituting a significant danger to public safety and security. More than half of the world's countries have experienced an ammunition storage area explosion over the past decades, resulting in severe humanitarian and socioeconomic consequences.¹ Thousands of people have been killed, injured, and displaced, and the livelihoods of entire communities have been disrupted. The humanitarian impact of unintended explosions is amplified when they occur in urban areas, as illustrated by ammunition depot explosions in a crowded area

in Brazzaville in 2011, resulting in approximately 500 killed, 2,500 injured, and 121,000 made homeless.²

Improper ammunition management is also at the root of the diversion of arms and ammunition to illicit markets and onward proliferation, thus fueling armed conflict, terrorism, and crime.³ Diverted conventional ammunition allows non-State actors, such as rebels, gangs, criminal organizations, and terrorist groups to enhance their military capabilities. Its explosive nature makes ammunition particularly attractive for the manufacture of improvised explosive devices (IEDs).

Essential for adequate stockpile management is the identification and disposal of obsolete, surplus, and unsafe

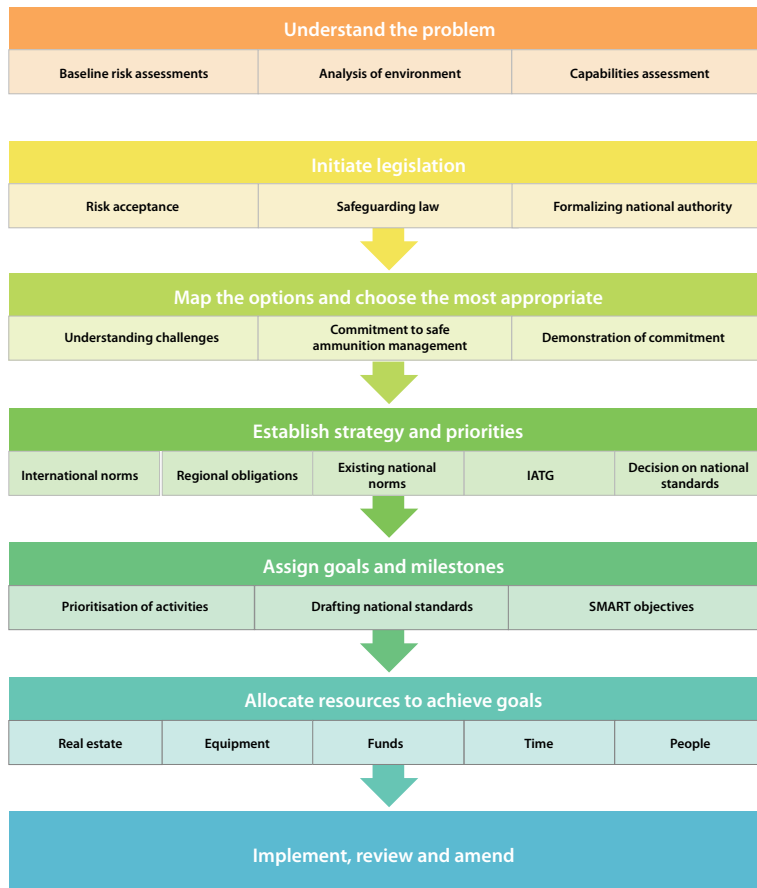


Figure 1: Outline process for developing national standards for ammunition management. Figure courtesy of UN SaferGuard.

ammunition. Often, the entirety of the national ammunition stockpile is seen as strategically and operationally valuable, resulting in the accumulation of surpluses and unsafe ammunition that pose a significant and completely avoidable risk.⁴

In many developing and conflict-affected countries, defective stockpile management has been assessed as the norm rather than the exception, notably due to the lack of resources, infrastructure, and trained personnel. In these circumstances, addressing the matter of surpluses also requires a focus on the lack of appropriate laws, policies, and procedures as well as the lack of political awareness. In the absence of such a holistic approach to ammunition management, governments often remain unaware of surplus stocks, and national stockpiles continue to be a risk to public safety and a source for crime and armed violence.⁴

INTERNATIONAL EFFORTS IN AMMUNITION MANAGEMENT

In recognition of the threats of accidental explosions and diversion, international efforts to promote the safe and secure management of ammunition have increased in recent years,

as has the demand for relevant technical support. At the request of the General Assembly (A/RES/63/61), the United Nations developed the International Ammunition Technical Guidelines (IATG) in 2011 to ensure a consistent delivery of high-quality advice and support in ammunition management. The UN SaferGuard Programme was simultaneously established as the corresponding knowledge management platform to oversee and disseminate the IATG.⁵

The United Nations also promotes safe and secure ammunition management in the broader context of the 2030 Agenda for Sustainable Development, in particular Goal 16 on peace, justice, and strong institutions and its target related to a significant reduction in illicit arms flows. Moreover, securing excessive and poorly-managed ammunition stockpiles constitutes a key component in realizing the “Disarmament that Saves Lives” pillar of the Secretary-General’s agenda for disarmament, “Securing Our Common Future.”⁶ The Secretary-General calls for more effective State and regional action on excessive and poorly-maintained stockpiles to prevent serious humanitarian hazards that jeopardize

the implementation of the Sustainable Development Goals (Action 22).

VALUE OF THE IATG

Effective application of the IATG mitigates the dangers of unwanted explosions and frequent diversion. With the IATG, States have at their disposal practical, neutral, and authoritative guidance for ammunition stockpile management. This guidance offers common language and a coherent reference point in the form of globally accepted good practices. Compiled in 12 thematic volumes and 45 modules, the IATG represent a comprehensive and gradual approach to life-cycle management of ammunition.

Importantly, the IATG take into account diversity in States’ capacities. They do so by equating activities necessary for safe, efficient, and effective stockpile management to one of three risk-reduction process levels (RRPLs). States can utilize the RRPL system in addressing the safety and security of their ammunition in a gradual, incremental fashion: the degree of complexity of each task and the resources required for its implementation determines to which RRPL it is assigned.



The IATG support documents are available for download on the UNODA, UNIDIR, and AMAT websites.
Image courtesy of UN SaferGuard.

Maintaining stockpile management processes at the basic level (RRPL 1) already significantly reduces the brazen risks associated to ammunition.

Using the RRPL framework as a baseline in determining the condition of their ammunition stocks, States can also identify key safety and security issues, such as prioritizing national standards development and implementation in order to optimize the use of resources and capabilities.⁷

Applying the IATG at the national level is not merely a technical undertaking. Insufficient risk awareness; absence of institutional, legislative, and operational frameworks; and lack of staff capacity and skills are recognized as common characteristics of inadequate management of State-owned ammunition stockpiles.⁷ The sustainable application of the IATG thus requires a holistic approach including the establishment of a normative framework, organizational structure, equipment and infrastructure, personnel management, institutionalized training, and requisite financial resources.




APPLICATION OF THE IATG

The IATG are not meant to be a blueprint that can be replicated at the national level, regardless of the circumstances. Instead, they provide the underpinning principles and guidance on which national standards, processes, and technical operating procedures should be developed.⁷ Based on guidance in the IATG, States should establish an appropriate legislative framework, formalize a respective national authority, and approve tolerable risk levels. States may also adopt relevant IATG modules as the basis for national standards.⁷

A critical component of a holistic ammunition management approach is the development of a national strategy or action plan with realistic goals and milestones. Recognizing and taking ownership of ammunition safety and security challenges

at the State level is paramount to achieving a shared national vision on long-term objectives. This strategy enables States to prioritize activities and assigns roles and responsibilities more effectively. By defining clear goals and milestones, States can demonstrate their understanding of the challenge, ability to plan in the long-term, and that response options were adequately considered. This public commitment to addressing the challenges pertaining to ammunition stockpiles can give the international community confidence to provide required resources and technical support.⁷

To facilitate IATG dissemination, the UN SaferGuard Programme developed a series of resources to support national authorities, regional organizations, and partners on the ground in their efforts toward safe, secure, and efficient ammunition stockpile management. The IATG implementation support toolkit provides web-based applications for use by ammunition experts in their daily work.⁵ These resources are also useful in communicating risks to leaders, raising awareness of the risks arising from inadequate ammunition management, as well as minimum safety and security remedies. Most recently, the UN SaferGuard Programme published three support guides to make the IATG more accessible. Besides enhancing the understanding of the IATG, these resources increase their usability within national ammunition management systems.

-  Critical Path Guide to the International Ammunition Technical Guidelines assists users in navigating the principles, methodology, and technical content of the IATG.⁸
-  A Guide to Developing National Standards for Ammunition Management supports States in the development of IATG-based national standards and an organizational framework for effective, coordinated, and sustainable national ammunition management.⁹
-  Utilizing the IATG in Conflict-Affected and Low-Capacity Environments offers guidance on how basic ammunition stockpile safety and security can be improved in conflict-affected and low-capacity environments.¹⁰

To promote comprehensive and sustainable application of the IATG, translation of the IATG and its support resources into different languages is an important requirement. While the full version of the IATG is available in English, Arabic, Portuguese, and Russian, the UN SaferGuard Programme is currently translating all modules and support resources into French and Spanish.



Laser-marking of 9 mm ammunition in Lima, Peru, 2018. Image courtesy of UNLIREC.

INTERNATIONAL COOPERATION AND ASSISTANCE

International cooperation and assistance is often essential to addressing problems associated with national ammunition stockpiles. Immediate, short-term assistance interventions by specialist organizations can be crucial in preventing humanitarian disasters. However, inadequate ammunition management cannot be sustainably addressed from the outside through only discrete activities such as the delivery of training packages, construction of infrastructure, and the destruction of stockpiles. Experience has shown that comprehensive, nationally-owned approaches are more effective in the long term, gradually establishing the required knowledge, capacity, and national systems for safe and secure ammunition management.⁷

There is an increasing number of projects aimed at developing ammunition management capacities across the globe. Such efforts are undertaken through multiple channels by various actors and sometimes involve insufficient coordination and duplication of efforts. Those States offering and receiving assistance, as well as organizations building capacities on the ground, would benefit from coordinating activities and information sharing. A number of regional organizations have an active role in channeling assistance and stimulating national buy-in. Such regional cooperation is key in consolidating lessons learned from similar activities and in capitalizing on expertise relevant to other countries or organizations.³

Evaluating the impact of international cooperation and assistance can be difficult. Assistance-providing States and organizations that develop coherent indicators can better observe and capture changes on the ground, including with regards to national normative frameworks, organizational structures and procedures, training and doctrine development,

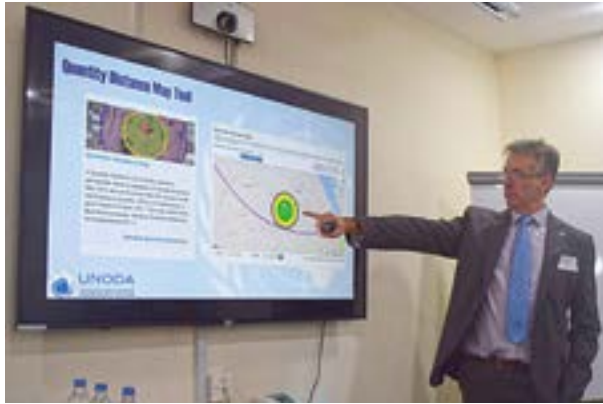
equipment and maintenance, personnel management, and finances and infrastructure.³ Besides measuring progress with indicators, project results should be made publicly available so stakeholders can better understand specific challenges and respond effectively in different contexts.

AMMUNITION MANAGEMENT ADVISORY TEAM

To contribute to more effective and sustainable action on ammunition management, the United Nations Office for Disarmament Affairs (UNODA) and the Geneva International Centre for Humanitarian Demining (GICHD) jointly established the Ammunition Management Advisory Team (AMAT), a Geneva-based technical assistance mechanism. Eleven AMAT seeks to enhance State and regional action on safe and secure ammunition management in line with the U.N. Secretary-General's agenda for disarmament. Besides providing sustainable technical support and assistance in accordance with the IATG, it contributes to making international cooperation and assistance more coherent and effective by developing a global information platform on ammunition management capacity and by facilitating meetings to match needs, resources, and expertise.



A below ground level ammunition storage facility in Bagram, Afghanistan, constructed by The HALO Trust. Image courtesy of The HALO Trust.



UNRC regional outreach event and training course on IATG in Nepal in 2018.
Image courtesy of GICHD.

CONCLUSION

Over the past decade, governments have increasingly engaged in ammunition safety and security topics, and demand for technical management support is on the rise. A growing number of States as well as international and regional NGOs now provide financial support and technical assistance in this area. The financial implications and technical capacity requirements in safe and effective management of ammunition are often significant. In this regard, international cooperation and assistance has become a central component of efforts to address ammunition safety and security. These efforts have been strengthened by the availability of the U.N.-developed, universally accepted IATG.

While in recent years there have been important developments in this area, major challenges remain. Many States continue to be at high risk of diversion and accidental explosions. Holistic approaches need to incorporate greater awareness of the risks from inadequate ammunition management, along with acceptance of responsibility for risk mitigation, development of appropriate laws, policies and procedures, as well as capacity-building.

States with limited capacities can benefit from IATG application by incrementally reducing risk, thus making communities safer and more secure. The IATG can be used for developing national frameworks, prioritizing those activity areas that need to be addressed urgently. Establishing national strategies, standards, and action plans that reflect the IATG in their goals and incremental targets is critical for a sustainable ammunition management system and may also attract external support and resources.

The availability of the IATG in an increasing number of languages as well as the expansion of supporting resources under the UN SaferGuard Programme make the IATG more accessible and facilitate their application at the national level.

The newly established AMAT seeks to accelerate global outreach and capacity-building efforts in line with the IATG and promotes effective and sustainable international cooperation and assistance. This has significant potential to improve national ammunition management policy and practices in many countries.

States and organizations continue enhancing their engagement in the area of safe and secure ammunition management. Deepened commitment, increased awareness, more effective coordination of efforts, and the availability of consistent technical capacity to provide assistance are key components for achieving sustainable change on the ground. ©

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Nora Allgaier
Associate Political Affairs Officer
UNODA




Nora Allgaier is an Associate Political Affairs Officer in the Conventional Arms Branch of the United Nations Office for Disarmament Affairs (UNODA). Before joining UNODA, Allgaier served as a Protection Analyst with the UN Women Multi-Country Office for India, Bhutan, Maldives, and Sri Lanka, supporting the Women, Peace and Security Programme.

Previously, she worked in the field of disarmament and mine action with the Geneva Disarmament Platform, the Geneva International Centre for Humanitarian Demining (GICHD), and DanChurchAid in Thailand. Allgaier holds a bachelor of arts in international relations from the University of Geneva and a master of science in comparative politics (conflict studies) from the London School of Economics and Political Science.

Samuel Paunila
Head, Ammunition Management Advisory Team
GICHD



Samuel Paunila heads the Ammunition Management Advisory Team (AMAT), a Geneva-based joint response mechanism of the GICHD and the UN SaferGuard Programme. From 2013 to 2018, Paunila conducted the GICHD's activities related to explosive weapons, residual explosive contamination, and ammunition. From 2003 to 2012, he directed the humanitarian mine action, ammunition disposal, and armed violence reduction program with Danish Refugee Council in Africa, Asia, and the Middle East. Prior to this, he supervised explosive ordnance disposal and ammunition engineering operations and peacekeeping units with the Finnish Defence Force. Work has taken him to over forty countries with the longest missions in Afghanistan, the former Yugoslavia, Sri Lanka, and Uganda. First graduated as ammunition and weapon systems technical officer, Paunila holds a bachelor of science in automation engineering and a master of science in resilience from Cranfield University, Defence Academy of the United Kingdom.



More Bang for their Buck: Enhancing the Sustainability of Surplus Ammunition Destruction Programs

by Joe Farha [BICC], Matthias Krötz [BICC], and Einas Osman Abdalla Mohammed [African Union Commission]

Dealing with stockpiles of surplus ammunition¹ remains a key challenge for many African countries. In the last 10 years, at least 38 ammunition sites across Africa reportedly experienced unplanned explosions, causing injury and loss of life as well as significant damage to infrastructure and the environment.² Numerous reasons such as overstocking, inadequate storage facilities due to insufficient resources, inadequate capabilities of storage sites, or simply unstable ammunition may be the cause of these unplanned detonations. These factors are often exacerbated by personnel having a limited knowledge and awareness, or insufficient training on relevant subjects such as explosive compatibility groups or ammunition life cycles. Regardless of the reasons outlined previously, the destruction of surplus and/or deteriorating ammunition is required as part of a general physical

security and stockpile management (PSSM) regime, in particular to reduce the risk of unplanned explosions at ammunition sites (UEMS).

During the past decade the international community provided substantial funding for surplus destruction activities to countries in sub-Saharan Africa. However, this funding was primarily used by external implementing agencies to destroy existing stockpiles, rather than equipping the countries in which destruction activities are undertaken with the skill sets and tools to manage their own destruction programs, thus lessening their dependence on foreign expertise. This article is therefore meant to encourage donors, implementing agencies, and beneficiaries to consider interventions through a more locally sustainable lens and involve local parties more inclusively in the design and implementation of ammunition

(Above) Degraded and dysfunctional ammunition is often stored in munition depots across the continent despite its unserviceability. Reasons for the storage of degraded ammunition are due to limited awareness, care, or destruction capacities.

All images courtesy of Nikhil Acharya, BICC.

destruction processes. In order to affect a real change in surplus ammunition management, it is not enough to just deal with existing surplus stockpiles; the community needs to ensure that partnering countries are able to independently prevent the future buildup of surplus stockpiles.

This article draws attention to the common procedures and practices of implementing agencies, partnering countries, and donors, before outlining lessons learned and suggesting potential ways of creating more participatory, sustainable, surplus-destruction projects across Africa.

ISSUES WITH CURRENT APPROACHES TO THE MANAGEMENT AND DESTRUCTION OF SURPLUS MUNITION

The need for local ownership over the management and destruction processes of surplus stockpiles of ammunition is reflected in myriad reports, international best practice standards, as well as relevant legal instruments in this field including the Bamako Declaration Article 3(iv);³ the Economic Community of West African States (ECOWAS) Convention Article 17;⁴ Kinshasa Convention Article 14; Nairobi Protocol Article 80;⁶ and the Silencing the Guns Continental Plan of Action on the Control of Illicit Small Arms and Light Weapons. The International Ammunition Technical Guidelines implicitly call for the development of local capabilities in this area (10.2.5 and 10.2.6),⁷ and external implementing partners conduct relatively short-term training and capacity-building projects. However this often happens in an ad hoc manner, depending on the nature, scale, resources of the intervention, and strategic priorities of the donors, and is not always approached with considerations of long-term sustainability in mind.

There is a need and desire for the skills and infrastructure gaps in this area to be filled by local, national, and regional bodies. This is needed in order to address the issue of ammunition destruction at an early enough stage to prevent the build-up of surpluses before they become a security and safety threat to the state and civilian population in the surrounding areas. For this to occur the capabilities must be developed and maintained at the local, national, or regional levels.

Short-term projects and interventions may fail to address related gaps in management and destruction processes outside of the narrow timeframe in which the implementing agencies operate. These capability gaps stem partly from the way in which donors operate. Thorough ammunition-life-cycle management is an expensive and time-consuming process, thus donors tend to favor short-term projects focusing on the destruction of specific stockpiles. As well as limiting the possibilities of embedding a national system capable of identifying and destroying surpluses or degraded ammunition,

interventions may only focus on parts of the destruction requirements that a country needs. This approach may be driven by a number of factors including the issue that implementing agencies will follow donor parameters and focus purely on the material destruction of ammunition instead of devoting the necessary time and expertise to building capacity of the local technical staff and decision makers.

Additionally, countries often request assistance that is limited to expensive infrastructure or equipment procurement. For donors, assistance with actual destruction activities is comparatively cheaper; however, capacity development, risk awareness education, and the development of locally applicable tools and institutional learning to generate knowledge for domestic security agencies are being neglected.⁷ Although the provision of relevant equipment is often a necessary component of destruction programs, such equipment is often not used or maintained once the intervention from the implementing agency or donor concludes. This in turn decreases the likelihood of future funding, as donors question the commitment of the recipient. Countries receiving support should therefore not be passively involved in the implementation of activities by foreign intervention agencies but must operate in true partnership with them by actively taking part in the design and implementation processes.

These approaches may lead to uneven coverage of destruction activities, with assistance being concentrated in certain regions and focusing on specific types of intervention. These interventions may be more attractive from a short-term “marketing” perspective, producing swift, publicly verifiable outputs rather than more anonymous long-term benefits. Assistance measures therefore often support physical measures such as the destruction of surplus ammunition or the construction/rehabilitation of ammunition sites in countries that are already of interest to the international community rather than those with more basic infrastructure or with complex bureaucracies. It is therefore the case that funding tends to cluster around prominently positioned countries who may not be able to absorb the assistance provided while other countries with similar or higher demands command less attention and do not receive assistance in overcoming existing difficulties relating to surplus destruction.

The questions of strategic relationships and/or geopolitical dynamics also feed into determining which states may benefit from intervention support. These points all have the potential to create a cyclical knock-on effect: countries who do not receive support focus less on the very governance issues such as ammunition management and capacity that deter donors from investing in the first place. Therefore better coordination is needed between donors and established African institutions, such as the African Union, the Regional Economic



Surplus and damaged RPG warheads. These explosives pose a serious threat to the lives of storage keepers, military personnel, and civilians. By separating and destroying surplus ammunition, UEMS can be reduced significantly.

Communities, or regional bodies to avoid duplication and ineffectiveness of the support provided. Apart from inefficiency, duplication of efforts by different agencies and their donors might even hamper progress by creating competition among implementing agencies and undermining national ownership.

SUGGESTIONS FOR FUTURE INTERVENTIONS

As discussed, interventions are focused on the destruction of ammunition through external implementing agents. However, this approach may only relieve the burden for a short period of time, failing in the longer term to address broader questions relating to the material conditions and management activities undertaken in the intervention countries. These potential gaps ultimately result in the formation of a dependency

cycle of ongoing external interventions for ammunition surplus destruction. Therefore in order to lessen the dependence of beneficiary states on repeated interventions from external donors and to allow states to overcome UEMS caused by overcrowded unstable stockpile depots the following changes in approach are proposed.

Implementing agencies must work more closely with respective countries in the design and execution of surplus destruction programs. Rather than treating surplus destruction as an activity in isolation, states and implementing agencies may consider the design and establishment of joint, tailored, life-cycle-management systems for ammunition in accordance with international standards. Using this broader approach would involve the inclusion of PSSM into

the national curricula of relevant security forces, the development of specific policies relating to management systems, as well as the introduction and implementation of functional standard operating procedures, all of which are necessary to generate functioning surplus munition destruction capabilities. This is crucial, as long-term threat mitigation of surplus ammunition can only realistically happen through improving and streamlining the acquisition, distribution, and disposal processes of ammunition. This has the double benefit of reducing both the costs and the risks around surplus stockpiles, which then require further interventions to resolve. Additionally, specialized and explosive ordnance disposal (EOD) capacities and equipment must be acquired in order to build in-country capabilities.

The onus to ensure sustainability cannot solely be the donors'; beneficiary countries must also follow through on the commitments they give to donors. Each state has an individual obligation to limit the risks and hazards of ammunition stockpiles, both to personnel working directly on those sites as well as civilians living in the surrounding areas. States should thus be obliged to report on their own activities in this area on a regular and standardized basis and should actively seek ways to mitigate potential risks at an early stage, rather than ignoring the issues posed by increasing stockpiles.⁹ Reports should be publicly available and aimed at donors, relevant international mechanisms as well as stakeholders and implementing agencies.

For countries with capacity and capability issues where it may not be possible to develop or maintain EOD or arms and ammunition destruction expertise, states should request support from regional economic communities and regional bodies dealing with these subjects to establish regional pools of experts—such as train-the-trainers programs to support national surplus management and disposal undertakings. Promising examples of the approaches that may be used can be drawn from the activities of ECOWAS and the Regional Centre on Small Arms in the Great Lakes Region, the Horn of Africa and Bordering States in their PSSM train-the-trainers programs.

Donor countries and institutions are bound to short-term, high-impact timelines. Projects are thus often commissioned for only two-to-three years. Sustainable change is, however, not achieved in such a short time frame; changing personnel and institutional behavior requires time to adjust. Therefore, donors should consider committing to selected projects for a longer period of time, rather than distributing available funding across a larger number of countries for shorter periods. In order to allow partnering countries to overcome surplus stockpiles and the dependency on external actors in driving interventions, priority should be given to supporting

partnering countries in combating the root causes of surplus accumulation. This would decrease the dependency on foreign financial resources and capacities, a situation that is clearly in the interest of all donors, as financial resources can be channeled into a sustainable solution, rather than a quick fix, thus representing more bang for donors (and taxpayers) buck than the current situation allows. ©

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Joseph Farha
Project Coordinator
BICC



Joe Farha joined BICC in December 2018. Farha holds an undergraduate degree in law from the University of Exeter and a master's degree in Islamic societies and cultures from the University of London School of Oriental and African Studies (SOAS). He is currently undertaking a Ph.D. in the law department at the Free University Berlin where the focus of his research is the intersection of police technologies and fundamental rights. Farha

has worked in the fields of SA/LW control, arms transfer controls, and research on the arms and security trade since 2008. As well as research activities, his work has included policy development and the provision of training and capacity-building as well as technical advice for national and multilateral bodies in the Middle East and North Africa, South Caucasus, and Southeast Asia regions as well as for United Nations and European Union institutions.

Matthias Krötz
Small Arms and Light Weapons Control Advisor Seconded to the African Union Commission
BICC



Matthias Krötz joined BICC in September 2016. Krötz holds a bachelor's degree in Political Science from the University of Bremen and a master's in international studies/peace and conflict research at the Goethe University Frankfurt/Technical University Darmstadt, focusing on the crossroads between arms imports and the onset of civil wars in sub-Saharan Africa. Before joining BICC, Matthias worked as a consultant for different programs of the German development cooperation in Ethiopia focusing on peace and security and risk mitigation. Currently, Krötz is the seconded SA/LW Control Advisor to the African Union Defence and Security Division.

Einas Osman Abdalla Mohammed
Senior Policy Officer and Acting Head of the Defence and Security Division
African Union Commission



Einas Osman Abdalla Mohammed has served the African Union Commission since 2014 as Senior Policy Officer for Disarmament and Non-Proliferation Affairs in the AU's Defence and Security Division (DSD) and has been appointed as Acting Head in July 2017. She holds a master's degree in international relations from the Free University of Berlin and a post-graduate diploma in human rights law from the University of Khartoum. Within her

role, she is responsible for DSD's projects on small arms control, weapons of mass destruction disarmament and nonproliferation, and mine action. She first joined DSD in 2010 and held the position of Political Officer for Counter-Terrorism and Strategic Issues, in which she contributed to the design and implementation of initiatives relating to the criminal justice response to terrorism, regional intelligence cooperation, and supporting victims of terrorism.



KEY PERFORMANCE INDICATORS AND HMA TIME TO STANDARDIZE?

by Roly Evans [GICHD] and David Hewitson [Fenix Insight, Ltd]

Measuring performance is the norm across a range of human activities. But is it a norm in humanitarian mine action (HMA)? Some might suggest that it is. However, if we measure our performance, it is unclear whether we do so in a standardized way so that meaningful comparisons can be made. HMA lacks standardized indicators, whether it is for items of explosive ordnance (EO) found and destroyed, m² of land released, or more general outcomes such as internally displaced persons returning to an area once cleared. Indicators can of course be ignored, misused, misreported, misunderstood. The playing field for operators may not be level. However, this is not a reason not to use key performance indicators (KPIs); it is a reason for standardizing their use. The time is overdue for mine action to develop standard indicators with agreed definitions in order to measure, understand, and compare performance more accurately.

INCREASING UNDERSTANDING TO REDUCE RISK

In the new International Mine Action Standard (IMAS) 07.14, risk is defined as “the effect of uncertainty on objectives.”¹ Uncertainty arises when we don’t have enough information on a subject or situation to be confident about taking the right decisions. An important part of the overall information and risk management process is the identification and use of KPIs that tell us about important aspects of our operational activity and the extent to which we are succeeding in pursuing goals and objectives. This article looks at the question of KPIs within HMA. It identifies specific KPIs that are likely to be particularly relevant and considers both the opportunities that the adoption of such indicators bring as well as some of the risks associated with them.

Photo above: Pattern-minefield clearance by MAG (Mines Advisory Group) in Mantai, Sri Lanka. The locations of cleared anti-personnel mines are represented by yellow pickets. Clearance of dense patterns minefields in countries such as Sri Lanka can give impressive KPIs such as low m²/mine cleared figures.
Image courtesy of GICHD/Roly Evans.

PAST PERFORMANCE MEASUREMENT IN HMA

Performance measurement has a mixed history in HMA. In the early years of HMA, the promotion and pursuit of individual performance indicators led to distortion of some management decision-making. The pursuit of m^2 of cleared land sometimes resulted in the expenditure of time and money clearing large areas that contained no explosive hazards. Money was often wasted on areas that need not have been a priority at the time or that were not put to subsequent use. Chasing the number of mines cleared sometimes led to the clearance of areas that had little or no impact on affected populations. Opportunities were missed to maximize the benefits provided to affected people.

In the 2000s, attention turned to how to avoid clearing land that did not contain hazards. Improved methods and approaches coalesced into the concepts known collectively as land release. More recently, additional efforts have been applied to concepts of results-based management and the need to understand better the outcomes and impacts accruing from the release of land.²

Historically, the focus on the figures m^2 “cleared” was understandable. The measurements were consistent with the intent of the *Anti-Personnel Mine Ban Convention* (APMBC), Article 5, where State Parties undertook “to ensure the destruction of all anti-personnel mines in mined areas under its jurisdiction or control ...”³ However, in isolation, m^2 don’t necessarily reveal much about how successful and efficient work has been. For a given area of land that was cleared, how would we decide whether the effort to clear that land was reasonable? Would it be m^2 /item of EO cleared? If so what level of effort would we deem acceptable? 100 m^2 /item, 1,000 m^2 /item, 10,000 m^2 /item, 100,000 m^2 /item? The type of item is, of course, relevant. One thousand m^2 /anti-personnel mine might be deemed reasonable, 1,000 m^2 /7.62 x 39 mm cartridge probably wouldn’t.

In the absence of clearly defined standards, operators often choose their own indicators, establishing their own rules for counting key data, and interpreting data reporting requirements in whatever ways seem to make the most sense or that yield the most favorable figures. Does any IMAS or National

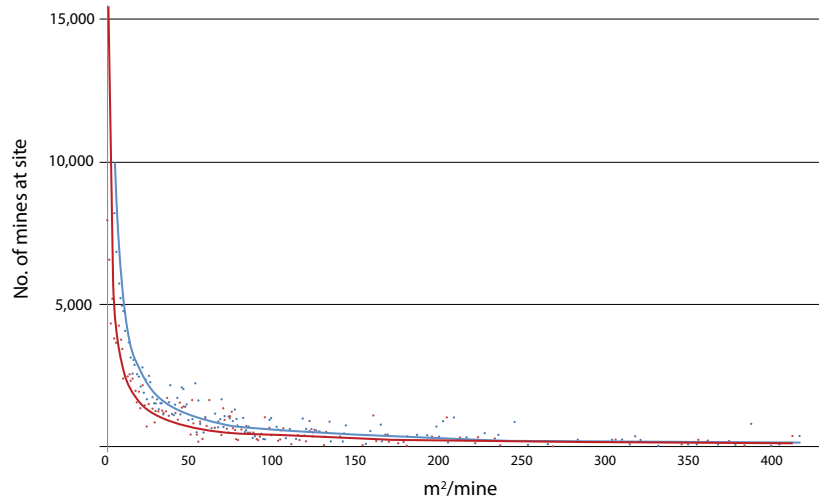


Figure 1. Analysis of m^2 /mine by number of mines at site, including “best fit” curves, Afghanistan pre-2009 in blue, 2009–2012 in red: Survey Action Center (SAC) Afghanistan Database Project 2012. The fact that the red line is lower than the blue line implies an increase in average land release targeting efficiency within the pre- and post-2009 figures. Base data was provided by the Mine Action Coordination Centre of Afghanistan (MACCA).

Figure courtesy of David Hewitson.

Mine Action Standard (NMAS) currently list standard KPIs for reporting? How many standard operating procedures (SOPs) detail standardized KPIs for reporting? The result is a situation in which there is a great deal of uncertainty about what constitutes “good” performance across the sector.

STANDARDIZATION OF KPIs IN HMA

Standardizing KPIs in HMA would bring important benefits. Donors and national mine action authorities (NMAAs) would be able to compare operational outputs and outcomes more easily. Operators would be more confident about demonstrating performance on a level playing field. The challenge is to agree which performance indicators should be standardized. Some *core* KPIs, especially in terms of land release, may be easy to identify while others might have more situation-specific value and be deemed discretionary. As a first step, it could be sensible to develop a set of core KPIs that can measure operational performance—especially but not exclusively in the context of land release—and a set of recognized discretionary KPIs that are available for use as and when relevant. Adopting standardized KPIs brings risks and challenges too. In order for data not to be misrepresented, common “counting rules” should be agreed and established, dictating clearly and unambiguously how data is to be measured, collected, recorded, and reported.

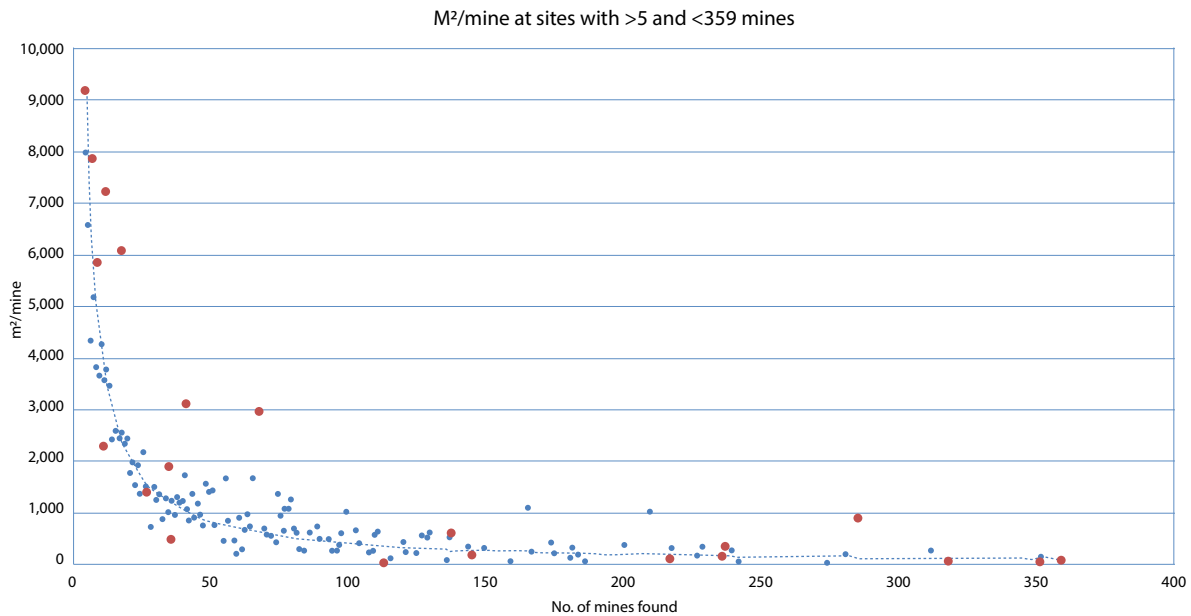


Figure 2. M^2/mine data from Tajikistan (in red) showing the generally close alignment with the data from Afghanistan (in blue): Survey Action Center Tajikistan Land Release Project Report 2011. Base data was provided by MACCA and the Tajikistan National Mine Action Centre (TNMAC).
Figure courtesy of David Hewitson.

POTENTIAL CORE KPIS

KPIs selected as core should relate directly and fundamentally to questions of success. In HMA success typically means working safely, minimizing environmental impact, completing work on time and on budget, ensuring that no hazard items are left in released land, and helping achieve results that make a real difference to affected people.

TARGETING OF EFFORT: M^2/EO item (Disaggregated)

The area cleared per hazard item is an indicator of efficiency in the targeting of assets. Mines in a well-recorded, intact, regular pattern are likely to be relatively easy to locate. Clearance work can focus on the specific rows where the mines are found, and decisions about when to stop work can be made early and with confidence. The m^2/mine KPI is likely to be very low (possibly in single figures). In an area subject to a cluster-munition strike, unexploded submunitions may be widely separated (within an overall footprint) and exhibit a limited pattern. The $m^2/\text{submunition}$ figure is likely to be higher (perhaps hundreds). In an area containing only one or two *nuisance* landmines, the figure may be over ten thousand. Figures for the clearance of general explosive remnants of war (ERW) may be different again. Disaggregation of EO type is essential to ensure that comparisons are *like-for-like* and to provide operations managers with meaningful information.

On the one hand, m^2/EO provides an indication of how easy (or difficult) it is to define the extent and distribution of contamination within an area. On the other, it reflects how successful operators are at defining the extent and arrangement of the contamination. Two organizations approaching a similar area of contamination could yield different m^2/item results reflecting the general availability of information, how well Non-technical Survey (NTS) was conducted, how well Technical Survey/clearance work drew on the results of the NTS, and how well decision-making worked during site operations.⁴

M^2/EO brings significant benefits and advantages. The first is that the two pieces of data necessary to calculate the KPI (m^2 and number of items) are perhaps the only two pieces of data that at least should be recorded at almost every land release site since the beginning of modern HMA. Secondly, analysis of this indicator in a number of countries suggests that, especially with respect to landmines, there is a remarkably consistent relationship between the number of mines found at a site and the amount of land that is investigated (Figure 2). Where there are few mines, it is relatively difficult to find them efficiently; where there are very many, it is much easier. The general statement may be obvious, but the nature of the curve that arises from the analysis suggests the potential to establish benchmark figures that could be applicable across many or all programs. Benchmarks need not generally be used as targets but instead reflect typical performance across a range of

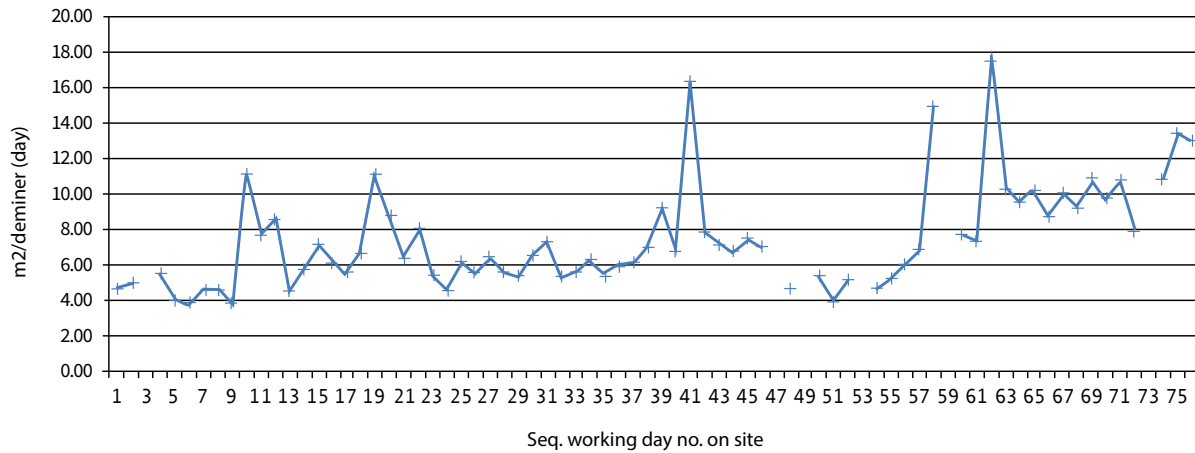


Figure 3. M² productivity/deminer, ratioed to a standard six-hour day equivalent (to ensure like-for-like comparability). A general upward trend in the KPI indicates deminers becoming familiar with site conditions. Stand out peaks in productivity were associated with areas where adjacent mines were blown in situ, breaking up nearby soil and vegetation, making it much easier for deminers to progress.
Figure courtesy of Fenix Insight Ltd.

operators, regions, and programs. In doing so, they help HMA managers understand where the performance of their operations sits relative to sector performance as a whole, identifying both occasions when above-benchmark performance could usefully be shared to help others benefit, and those when the reasons for below-benchmark performance should be questioned. With improved collection and analysis of performance data, a range of benchmarks could be established for different types of contamination, activities, and circumstances.

While m²/EO item helps us understand the efficiency of clearance activity, it also provides an indication of the effectiveness of decisions and activity undertaken earlier in the overall land release process: a low m²/EO item figure is also likely to reflect effective NTS and operational planning. KPIs often help us understand more than one aspect of an operational process, providing information about efficiency in one respect, effectiveness in another, and perhaps progress or compliance in yet another.

PRODUCTIVITY: M²/Asset/Time

Productivity, defined as the rate of production, has been widely measured in HMA for most of its history. It has clear value but needs to be handled carefully if it is to provide useful, comparable information about performance. The KPI can tell us the rate at which ground is being searched, how search rates change over time, how rates differ between sites and teams, and how rates relate to original planning assumptions. However, KPIs rarely tell the full story in isolation, and comparisons need to be done in context. If one team searches more m² in a given period of time than another, it does not necessarily mean it is more efficient. It does mean that operations managers should understand why such differences arise and be prepared to investigate if the causes of differences are not readily understandable.

Productivity KPIs are especially susceptible to misunderstanding if they do not offer like-for-like comparisons.

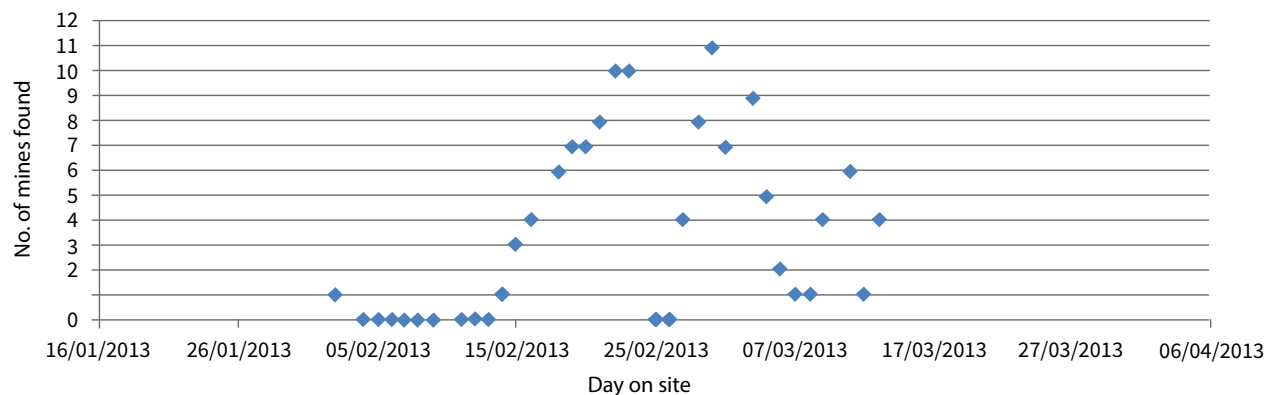


Figure 4. Mines found/day, a relatively clean site profile associated with a pattern minefield.
Figure courtesy of Fenix Insight Ltd.

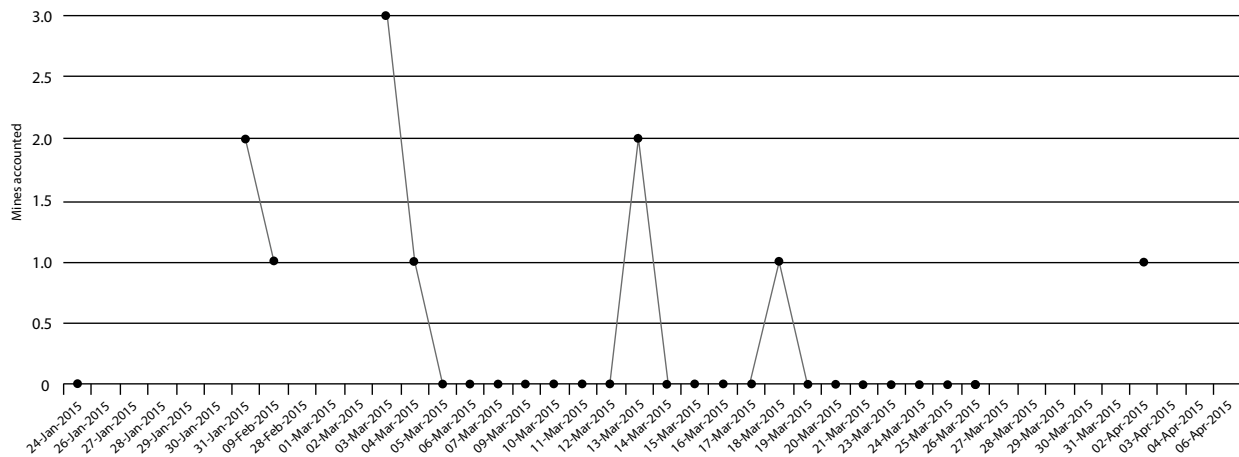


Figure 5. Mines found/day, an irregular profile associated with a mined area that is harder to “unlock.”
Figure courtesy of Fenix Insight Ltd.

Some programs choose to use m^2 /team/week; others use m^2 /deminer/day; others m^2 /deminer/hour. Not every team may be the same at all times; team numbers may fluctuate through sickness, leave rostering, or logistic constraints. The working week and day may vary reflecting weather conditions, travelling time, security issues, and other contextual factors. KPIs work best when they use unambiguous base data (m^2 , the deminer, and the hour are all uniquely defined), but even then it is important to ensure that common counting rules are adopted. If the same m^2 has been processed by machine, dog, and deminer, is it counted three times, under separate KPIs, or once under a single land released heading for instance?

Productivity in land release is also strongly influenced by local circumstances and conditions. High levels of metal contamination can require more time-consuming excavations, slowing progress. Metal contamination might be such that the only option is full excavation, an even slower search process. Contamination type, slope, vegetation, soil type, and ground conditions (e.g., hard, wet, etc.) may also have a significant effect.

QUALITY MANAGEMENT KPIs

A number of simple quality management KPIs are also of value to the sector. Typically these center on the occurrence and severity of nonconformities, identified by organizational unit (e.g., a team), date, and management system aspect; whether it relates to quality, safety, or the environment; which standard or SOP requirement has not been satisfied, etc. Such KPIs have value when comparing teams in the same operating environment, looking for trends in performance, and when identifying aspects of standards or procedures that seem to be causing difficulties. However, there are potential problems

when trying to compare differing quality management regimes in different countries. There is also the issue that many NMAS do not provide detail on the severity of different types of nonconformity. Accredited SOPs effectively list working requirements, but what requirements relate to major, minor, and critical nonconformities is also too often not specified clearly and consistently enough. Some contracts do specify, and IMAS 07.40 provides general guidance, but this is not universally applied. More clarity will be required in order for fair KPIs for quality management to be developed.

One quality KPI that may merit particular attention is EO remaining in released land. The absence of EO is a primary indicator of effectiveness of the land release process. If a hazard item is missed it indicates that the land release process has failed in some regard. Deciding what to do in the event that this specific nonconformity KPI is “non-zero” relies upon a thorough and reliable investigation and root cause analysis leading to appropriate and effective corrective and preventive actions.⁵ This is an important indicator, but one that needs to be used with care by authorities, donors, and clients if operators are not to be frightened into avoiding or concealing declarations to avoid punitive measures.⁶

MAKING A DIFFERENCE: OUTCOME INDICATORS

Land release is also effective when it releases land that is used to yield developmental value. Developing meaningful outcome indicators to improve understanding of the benefits that arise from HMA is a challenging task, one that has yet to be meaningfully addressed by donors, authorities, and operators within HMA. However, even in the absence of an agreed selection of such outcome KPIs, there are some indicators that

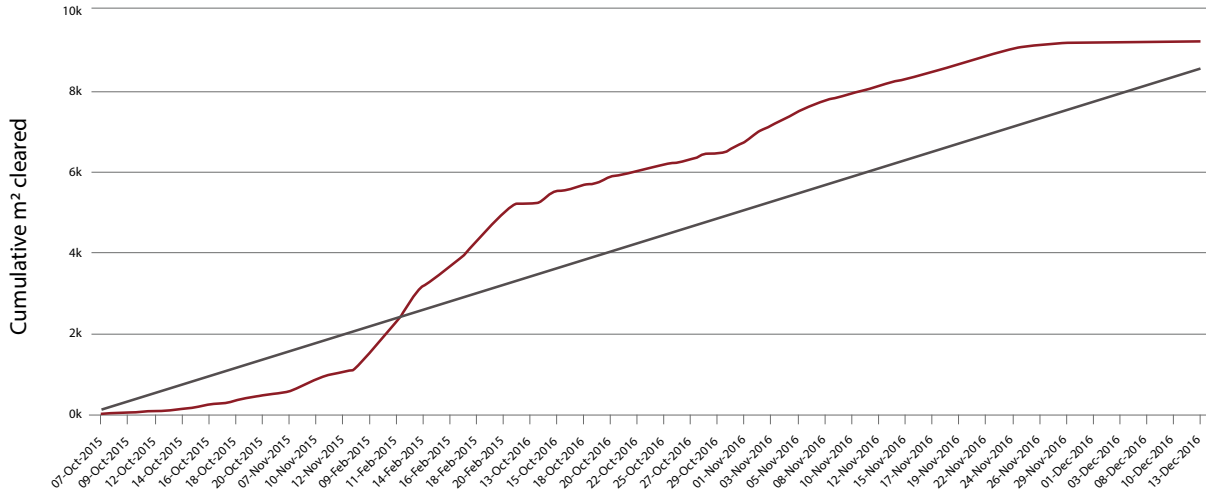


Figure 6. Progress chart showing a period when the production rate fell below the target line, followed by the deployment of additional clearance assets to increase the production rate and final completion around the target date. Figure courtesy of Fenix Insight Ltd.

could be adopted. The simplest is a comparison of the use of land following release against the expectation of its use reflected in the prioritization and planning process. If land is used in the way that was expected, it indicates that the overall tasking and land release process has been effective. If land is not used at all, or used for some unexpected purpose, then it indicates some failing in the overall system. Other KPIs that could be considered include the number of IDPs (internally displaced persons) returning/ha of released land, or number of IDPs returning/released buildings. HMA KPIs could potentially be developed and agreed that link directly to the Sustainable Development Goals (SDGs).

POSSIBLE DISCRETIONARY KPIs

Other KPIs may be useful and should be considered.

SITE CHARACTERISTICS: ITEMS FOUND PER WORKING DAY

Plotting the number of items found each working day brings a time-based, rather than a geographical perspective to land release. Once again, disaggregation of data is important. In a mined area, the shape of the KPI profile provides additional indications about how successfully the extent and distribution of contamination is being predicted. At regular, easy-to-define sites, a “clean” pattern might be expected. There may be a few mines at the beginning during “breaching” toward mine rows, a larger number during clearance in the main mined area, and a period when no mines are found at the end during “fade out” prior to the decision to declare the site complete.

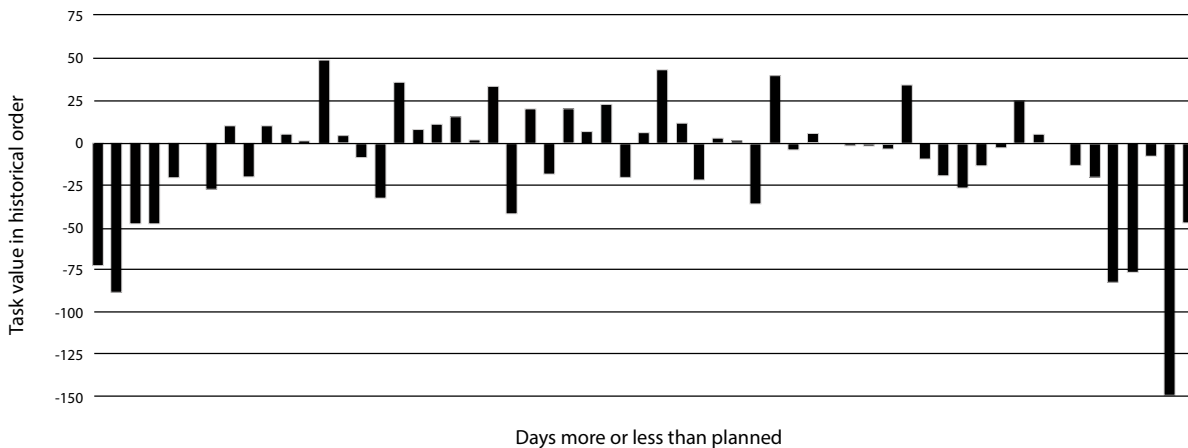


Figure 7. Duration variance by task. Tasks below the zero line were finished faster than expected; those above it later. In a perfectly planned project, all tasks would show as zero. In reality various “real world” factors may affect this KPI. Figure courtesy of Fenix Insight Ltd.



Metal contamination is one of the key factors affecting $m^2/\text{searcher}/\text{day}$. The image above shows an area where the battle area clearance (BAC) searcher has excavated many times for each m^2 in the search for explosive submunitions.

Image courtesy of Roly Evans.



BAC on a hillside in southern Lebanon. The rocky nature of the ground, the vegetation, and the steep slope, along with the hot working conditions, are all factors that might affect KPIs such as $m^2/\text{searcher}/\text{day}$.

Image courtesy of Roly Evans.

At sites where less information is available, or where it is harder to predict where contamination may be present, less regular profiles are likely.

PROGRESS: Proportion of Task Achievement

The percentage of task objectives achieved against time is one of the simplest indicators, but it is often ignored in HMA. It requires managers to predict both output at a site and the expected duration of work, which is not always a straightforward task. Even where no deadline is set, or where there may be some uncertainty about the volume of work expected at the site, HMA managers should be encouraged to set figures and monitor progress toward them, even if time and output targets need to be updated in light of new information.

PLANNING VARIANCE

Comparisons between when tasks are expected to be implemented against when they actually take place, and of planned duration against actual duration, provide indications of the reliability of planning processes. As with any KPI, there may be good reasons for differences between planned and actual activity, but managers should generally expect the reliability of planning to improve over time.

VIEWING KPIs IN CONTEXT

One of the erroneous arguments against the systematic use of KPIs in HMA is that they can be presented in a misleading way along the lines of the old apocryphal phrase, “lies, damn

lies, and statistics.” This is of course not a good argument for not using statistics or KPIs. It is, however, a good argument for not misusing data and indicators, as KPIs must be interpreted in context. Taken in isolation they can give rise to misleading or invalid conclusions. Comparison of the m^2/mine figures between a pattern and nuisance minefield could lead to an assumption that one was inefficient compared with the other, but nuisance minefields also need to be reduced and cleared. Different field conditions (i.e., with varying contamination and vegetation levels) may explain significant variation in performance figures at apparently similar sites. There is currently no standardized way of recording field conditions to help understand variations in performance figures. The ability to disaggregate performance data by site characteristics would provide further support to improved understanding and decision-making. The nature of the contamination present at a site also influences performance. One minefield might contain easy to detect metal-cased, anti-vehicle mines, another minimum-metal, anti-personnel mines that are extremely hard to detect. Other considerations include how dangerous a mine is during excavation and removal and whether booby-traps are present as well as the effects of aging and degradation.

The results of one KPI often help us monitor the quality of another. Much like the navigator of a ship looking for constant logical consistency between different sources of information about the position of the vessel, any inconsistency in the implications of different KPIs demands management attention to find out why. If the m^2/EO item for a typical team working in average conditions is low (implying that items are

likely to be found relatively frequently), but the finds/day figure is also low (implying that items are not found often) then it indicates a possible inconsistency requiring management attention—there may be many acceptable reasons, but there may also be an underlying data collection and reporting problem.

DATA COLLECTION

Indicators require accurate data. Unfortunately, HMA operators do not always collect enough data to a sufficient standard to generate meaningful KPIs. The first step therefore in generating any meaningful KPI is the collection of accurate and relevant data. In selecting what we want to monitor by means of KPIs, we are selecting what data we wish to collect. The use of electronic devices such as tablets and mobile phones has revolutionized reporting in HMA in the last decade. The standardized data input and the real-time view of operational data such methods enable—often immediately represented on dashboards—has been a huge help to the sector in several countries. However, regardless of the benefits of technology, the key to such data collection is the design of the actual forms, whether they are electronic or paper-based.

It is no exaggeration to suggest that forms are among the most important documents in HMA yet little attention is given to their design. A form should seek to capture, as accurately as possible, the necessary data. Long forms are rarely filled out carefully and there is a finite amount of data that operators can practically extract from the field. The imperative is therefore to select the most relevant data to capture. It is a choice, with data priorities preferably reflected in the forms. Ideally, an operator should decide the KPIs they wish to measure while designing the forms that will capture the all-important data in



Clearance of an AP minefield in dense vegetation. Such vegetation will significantly reduce the m²/deminer/day.
Image courtesy of Roly Evans.



A SafeLane Global Ltd site supervisor in a waterlogged minefield west of Mount Longdon, the Falkland Islands. Weather and the resulting ground conditions can have a significant effect on search and clearance KPIs.
Image courtesy of GICHD/Roly Evans.

the first place. Designing forms might not be the most glamorous job in HMA, but it is among the most important.

STANDARDIZED DATA REPORTING

Meaningful indicators also require standardized data reporting. The principles of common counting rules and like-for-like comparisons are essential, but these are not necessarily applied in HMA. For example, m² reported as land released often leads to the suspicion that the figure represents mostly cancelled land, a product that is much cheaper to produce than m² cleared. M² reported as cleared can be heavily inflated and doesn't always represent the area that has been fully searched or where hazards have actually been removed. It is still not clear that m² indicated as



An M-14 minimum-metal, anti-personnel mine from a site where the vegetation was removed through burning. Comparisons of m²/deminer/dour, m²/searcher/day, or mines found/day must take into account the nature of EO found in order to be valid.

Image courtesy of Roly Evans.

IED components in Iraq, March 2016. HMA is still to standardise how such devices may be reported into operator and national databases, not only to allow better reporting under Article 7 of the APMBC but also to enable such databases to be used meaningfully as risk management/threat assessment tools.

Image courtesy of Ollie Shepherd.

either cancelled, reduced, or cleared is reported consistently. For example, say an organization physically cleared 15 percent of a confirmed hazardous area (CHA) in order to find 100 anti-personnel mines a record indicates is present, how would the other 85 percent be reported? Would it be counted as cancelled, reduced, or cleared? There are reasonable arguments for each option. However, there are not yet common counting rules for such a scenario.

The reporting of EO is another area where all is not necessarily what it seemed to be in the past. Often a very general figure of unexploded ordnance (UXO) might be reported. What that type of UXO might be is too often unspecified. Sometimes it can simply be small arms ammunition, which in any case is not UXO but abandoned explosive ordnance (AXO), or it can be larger caliber items that have not been

armed or damaged. It is notable that much that is found on the battlefield is AXO. Firstly, correct reporting of ERW under Protocol V of the *Convention on Certain Conventional Weapons* defines ERW as either UXO or AXO.⁷ Best practice would require adherence to this protocol. Secondly, if operators routinely recorded whether an item of ordnance was armed or not, better systematic risk management would be possible. The issue has further been emphasized by the lack of standardized reporting of IED contamination, where the need for databases to act as a tool for risk or threat assessment is even greater. In Iraq and Syria there have been instances of IED components such as 9 V batteries being reported as IEDs in databases, leading to situations where reported figures on IEDs are false. Once again, the need to establish common counting rules and like-for-like comparisons is clear.

• **Areas.**

Total area released	7,929 m ²
Total area technically investigated	841 m ²
% area technically investigated	11%

• **Land release process performed (key performance indicators/ratios).**

Average demining rate	10.40 m ² /deminer/day (6hr)
Average efficiency	5.88 m ² /mine
Average deminer day/mine	0.57 deminer days (6hr)
BAC rate	648 m ² /deminer/day (6hr)

• **Quality non-conformances, complaints, accidents.** Nil

• **Recommendations for improvement.** Nil

• **Follow-up actions arising from the review.** Nil

INTEGRATING KPIS INTO DAILY WORK

KPIs are already being used by a number of clearance organizations who monitor their operational outputs by using dashboards. Some organizations integrate graphical representation of KPIs into key reporting documents. This way, the use of KPIs is fully integrated into the work of the program and has become a norm.

Dashboards are becoming standardized across HMA and can be an effective way of easily monitoring selected KPIs. If more KPIs are standardized across the

Figure 8. KPIs integrated into the Management Review of the Site Implementation Plan document for Minefield 096 in the Falkland Islands, December 2017. Note the KPIs selected to be recorded in this key document include total area released, total area “technically investigated,” percentage “technically investigated,” average daily deminer rate, average efficiency expressed in m²/mine, average deminer days/mine, and the BAC rate for areas of the CHA not contaminated with mines.

Figure courtesy of Fenix Insight Ltd and SafeLane Global Ltd.

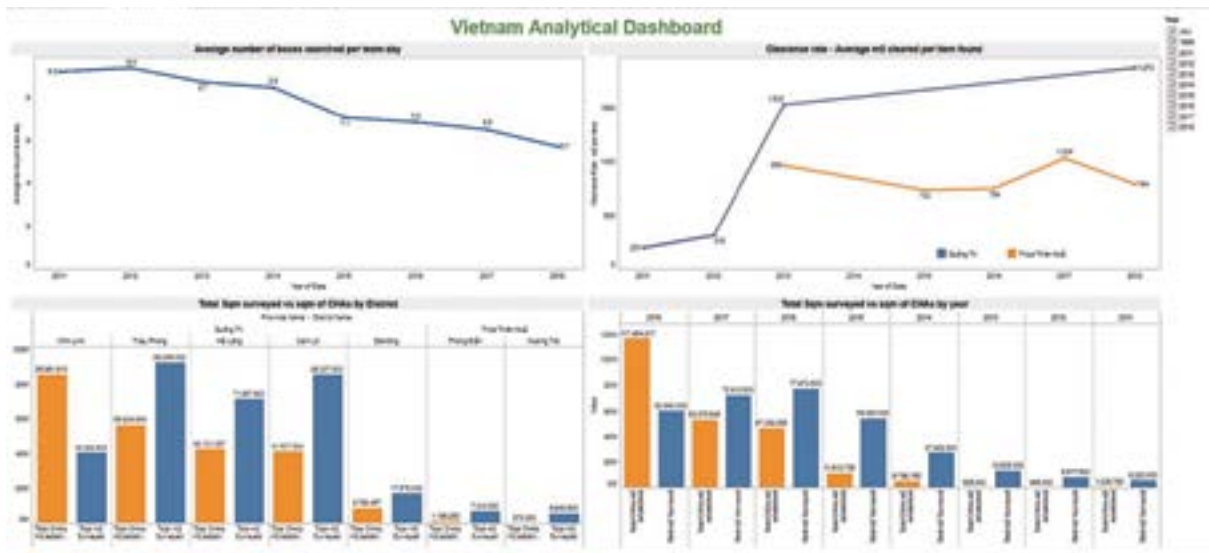


Figure 9. NPA Vietnam Analytical Dashboard showing KPIs concerned with the survey and clearance of areas contaminated by cluster munition remnants.

Figure courtesy of Norwegian People's Aid (NPA).

sector, dashboards showing comparative performance between operators at a national level will become easier to generate.

CONCLUSION

Assessing KPIs for operations analysis typically involves some form of comparison. For any form of comparison to be credible requires standardization. Basic KPIs that help us analyze operations in context should be welcomed by all in HMA, including donors, operators, and NMAAs.

This article has only briefly covered some of the more mainstream HMA KPIs that the industry might wish to consider formally adopting. Relevant KPIs not covered include reporting KPIs (e.g., proportion of reports accepted/rejected), accident KPIs, cost-related KPIs (a metric that has been subject to significant debate over the years in HMA), open burning open demolition (OBOD) KPIs such as the amount of explosive stores used relative to devices destroyed, and gender and diversity KPIs that typically reflect sex and age disaggregated data (SADD). These metrics could easily be deemed core KPIs and should be considered.

The scope of this subject is extensive but not always easy to address, and it is likely any progress to standardize KPIs will be incremental, possibly with an initial portion of core KPIs being agreed upon, accompanied by some discretionary KPIs being suggested. The development of a modest number of standardized KPIs, viewed strictly in context, is long overdue. Development of such KPIs could be done relatively quickly. It is time that HMA caught up with other industries. ©

See endnotes page 63

(The GICHD is currently developing a Technical Note for HMA on "KPIs and Mine Action." It would welcome any contributions on this subject (r.evans@gichd.org). Online training material covering the practical use of KPIs during HMA operations is available for free on the GICHD E-Learning Platform - <https://training.gichd.org/>)

Roly Evans

Advisor, Land Release, Operational Efficiency, and Training Development
GICHD



Roly Evans is an Advisor in Land Release, Operational Efficiency, and Training Development in the Risk Management Division at the Geneva International Centre for Humanitarian Demining (GICHD). He also covers training issues and conventional explosive ordnance disposal (EOD) including the Collaborative ORDnance data repository (CORD). He has worked in the fields of survey, clearance, EOD, and physical security and stockpile management in Africa, Europe, the Middle East, South Asia, and Southeast Asia.

David Hewitson

Director of Operations
Fenix Insight Ltd



David Hewitson is Director of Operations at Fenix Insight Ltd. He has been working in HMA since 1991, in the field as well as at the project, program, and higher organizational levels. He founded Fenix Insight Ltd with Colin King in 2011 and works with international operators, institutions, and governments on all aspects of explosive ordnance technical, operational, and strategic risk management around the world.

Practical Notes on the Application of Thermite Systems in Mine Action

by Robert Syfret and
Chris Cooper [The HALO Trust]



A RendSafe crucible.
Image courtesy of Suzanne Barlow/RendSafe.

There are numerous documents available online relating to the use of thermite systems for explosive ordnance disposal (EOD). However, most of the documents are either scientifically focused or address specific technical questions. This article provides broader practical information for mine action operators at the field and program levels.

Previously employed on a relatively small scale over the last five years, use of thermite as opposed to explosives for the destruction of landmines and explosive remnants of war (ERW) has increased over the last five years. This has been driven by greater engagement across the sector in countries with unstable security situations, and places with more restrictive legislation on the holding and use of explosives by mine action operators. In the past decade, The HALO Trust (HALO) has used thermite throughout the world, from Colombia to the Middle East, learning numerous lessons and best practices. The use of thermite will continue to expand across the sector, improving its cost effectiveness and expanding operator's knowledge of how to best employ the technology.

USE OF THERMITE IN MINE ACTION

In general terms, thermite is a mixture of chemicals that burn at a temperature of approximately 3,500°F/1,927°C, although there can be significant variation.¹ The mixture is typically composed of a fuel, such as aluminum or magnesium, and an oxidizer such as iron oxide. Thermite compositions require an ignition temperature of several thousand degrees, which vary according to the constituent chemicals.² Thermite has been used for many years commercially, most commonly to weld together railway tracks. As a non-explosive with minimal military use other than for *low-order* techniques, thermite cannot be used as an homemade explosive (HME).³ The hazard classification of particular systems may vary according to specifics of manufacture; however, they will typically be Class 4.1 hazardous materials (flammable solids).⁴ Some variants are supplied unmixed, in which case the separate chemicals may not even have a hazard classification. It should be noted that the packing group may vary if starter (ignition) systems are built into the item



A T-Jet thermite flare.
Image courtesy of Chris Cooper.

rather than packaged separately and assembled by the operator prior to use (T-Jet systems, for example, are provided as in the latter configuration).

The use of thermite in mine action has grown over the last two decades, and is now used globally in the field. Information from manufacturers shows it has been used in Australia, Cambodia, Colombia, Hong Kong, Iraq, Kosovo, Libya, Mozambique, Palau, Spain, Somalia, Somaliland, South Sudan, Syria, the United Kingdom, and Yemen; this list is not exhaustive. It has not, however, become the industry standard, as there are currently several disadvantages in its employment as an EOD tool when compared to high explosives (HE). These points are noted in the pros and cons paragraph. Having said this, companies producing thermite systems are making rapid advances and show keen interest in customer feedback while addressing previously-raised issues.

TYPES OF THERMITE SYSTEMS AND MANUFACTURERS

There are numerous thermite systems available that are manufactured around the world. They can be broken down into two basic types: molten flowing metals (molten penetrators) and pyrotechnical directional flares (thermite flares). In flare systems, the thermite is packed into a tube with a nozzle at one end. The heat of the flame produced is focused in order

to cut the casing and ignite the explosive contents within. Most molten penetrators consist of a crucible placed above the target. The thermite placed in the crucible produces a superheated metal that drips through a hole in the bottom onto the item, burning a hole through the casing and igniting any explosive contents via direct contact. Other versions without crucibles are also available.

It is not possible to give a complete list of available systems here; however, a contact list of manufacturers is provided at the end of this article.

PROS, CONS, AND PRACTICALITIES OF THERMITE

The most important feature for mine action programs is that thermite is not classed as an explosive. This means thermite can be used in places where insecurity or regulatory regimes make HE either illegal or extremely inadvisable. Its storage bears minimal infrastructure burden; and the transport categorization means most systems are suitable for air freight, making logistics chains and planning far easier. The first of these factors is of such significance that it is likely to drive the expansion of use more than any other. The downsides of thermite in comparison to explosives are its cost, the time it takes to carry out the final disposal of an item, and the limitations in its application, for example against more

complex ERW such as rocket motors. The following practical lessons have been learned by HALO, and should be of use to programs thinking of introducing thermite in the field:

Security. The closer mine action programs work to the conflict period, the greater the security implications of holding explosives and training staff in their use. In some locations the possession of explosives would place mine action operators at extreme risk of robbery by non-state armed groups or detention by local security services. In these instances, the option of using thermite may be what makes a clearance program possible.

Transportation. As noted previously, most thermite systems are designed to be transportable by air freight; however, different sizes or weights of particular models affect the cost of doing so, which must be accounted for when comparing unit costs to a program of one system over another.

Storage. Storage of thermite is hugely less restrictive, expensive, and logistically challenging than the storage of explosives.

Deflagration of target. Thermite can be used to attempt to target the fuze or booster of an item to produce a *high-order* detonation as soon as possible, or conversely to try and have as much explosive in the item as possible deflagrate prior to the heat causing the detonation of the explosive train. When used against anti-tank mines, it is possible to burn out a large proportion of the explosive prior to detonation, but there is a tendency for the combination of heat and pressure that builds during the burning to result in a “deflagration to detonation” transition of some of the fill. In situations where a munition is in an area where a high order is undesirable, the attempted use of deflagration can be a good option, but it cannot be guaranteed and must not be attempted unless the consequences of a complete detonation can be mitigated to an acceptable degree.

Soak periods. As with normal demolitions, a soak period after the last smoke seen at the target should be scrupulously observed. On many occasions in Syria during the disposal of PTAB 2.5Ms (anti-armor submunitions), a first explosion was followed several minutes later by a second or even third explosion—the longest period between first and last explosions being seven minutes. It is likely that these were caused by different components (nose fuze, base detonator) and the main fill exploding at different times. Given this is unlikely to happen during explosive demolition, the chances of such events are higher with thermite. The extended burning also mean there is an increased likelihood that materials surrounding the target will ignite, meaning a longer delay until the last smoke is seen and the soak period can commence. Thermite is therefore typically less time efficient than high explosive disposal.

Work timings. As a consequence of the long soak period, operations managers must consider cut-off times prior to the end

of the working day for beginning a thermite disposal, particularly when teams have to leave a site by a certain time for safety and security reasons, such as driving at night. An hour is a good initial start point.

Protective works. Further consideration must be given when building protective works around thermite demolitions than when building them for use with explosives. With thermite flares, the heat is liable to burn through sandbags. This means it is essential to use some material (e.g., plywood) as a roof above the burning area. If this is not done there is a risk that sand will spill over the flare and put it out before deflagration is complete, giving rise to obvious hazards. Protective works are harder to effectively build around a crucible initiated disposal as the works need to be built up and over the crucible. In comparison, a thermite torch may often be laid flat beside or built into the protective works to attack the target. Usually with explosives, the ERW high orders and all that is left is a crater within the protective works. If the ERW low orders (as sometimes occurs with thermite), exposing the results is more hazardous as the remains of the ERW, which may contain sensitive explosives, are often buried below the protective works.

Rocket motors. Thermite is unsuitable for the disposal of rocket motors in normal circumstances because there is a significant chance of igniting the propellant, thereby causing the rocket to move rapidly in an uncontrolled manner. Programs where rockets are present will need an alternative option.

Cost. Although the relative costs of explosives, detonators, detonator cords, and other items varies among countries, in general, the amount required for a single demolition will be a total of US\$2–3, compared with \$16 to \$90 for a thermite system.⁵ A precise calculation for each country would have to include other factors such as the additional storage and management costs for stocks of HE and ancillaries in order to give a true comparison. It should be noted that, typically, the cheaper thermite systems are only suitable for thinner-skinned items such as plastic anti-personnel mines, whereas targets such as artillery shells will require more expensive equipment.

Bulk demolitions. Thermite is highly unsuited to bulk demolitions. The variation in the effects of burning on the nature of the initiation of the explosives in ERW mean that consistent propagation of sympathetic detonation cannot be guaranteed. The results of partially-initiated bulk demolitions are extremely hazardous.

Cluster munition carriers. Although *in extremis*, thermite could be used to attack a cluster munition carrier, there is a higher chance that submunitions will be kicked out and then



This image shows a 25 lb HE shell attacked using a molten penetrator. The conical shape of the entry did not allow sufficient escape of gases during deflagration to completely prevent explosion; however, it is clear that the detonation that did occur lacked the violence of a high-order event.

Image courtesy of Chris Cooper.

have to be dealt with one at a time, after which they may potentially be in a more sensitive state than when in the parent container. Very detailed planning and risk assessment is therefore required.

Multiple items in close proximity. In areas where numerous items are gathered together (for example when gathered by locals), they cannot be targeted simultaneously by thermite as each item would probably initiate at different times, the first initiations potentially disrupting the setup of the remaining disposals. This could be addressed by the use of hook and line, or depending on the proximity and size of the items, by use of

individual protective works; however, most of the time explosives are the only means of conducting this operation cleanly.

Cluster munitions and other sensitive ERW (piezo, cocked strikers, etc.). These can be dealt with individually using thermite. The thermite torch lends itself best to this as it is a simple operation to align one next to the target, minimizing the risk of accidental contact during preparation of the operation.

Shaped charges. These are designed to project a plasma jet or slug in a particular direction. They are used to concentrate the explosive effect to penetrate armor. The shape charge is usually a cone or a concave disc. Collapsing the cone or disc during disposal disrupts the formation of the energetic jet or slug and can only be achieved by explosive means. Thermite may still be used but consideration of the direction of travel, protective works, and evacuation are the main means of mitigation. These are still put in place when using explosives that are more likely to prevent the jet or slug forming in the first place. If possible, targeting thermite at the portion of the explosive fill closest to the stand-off will make it much less likely that a high order resulting in the efficient formation of the plasma jet will occur.

Initiation systems. Bridge-wire initiation systems do not work with all variations of exploder. If too much current passes through the wire, it may break without heating the ignition mixture sufficiently. Other ignition systems have not proved 100 percent reliable.

Whenever ordering thermite systems, it is recommended to order an excess of initiators in order to allow for training and to provide spares in the case of operator error or system failure, as the particular starters required are unlikely to be available from other sources in-country, or easily replaced with a self-made alternative.

Identifying evidence of complete deflagration. Thermite systems may burn out an item and leave a hole with evidence of burning. It is difficult to confirm if all the explosive fill/detonator has burned out, requiring it to be attacked a second or third time (or potentially even more). It was also found where bare fuzes are attacked with thermite, the booster may function but the detonator does not, requiring a second attack (if the fuze is unarmed the detonator may well be out of line with the booster and therefore protected from its effect).

Small vs. large items. Generally, items of 57 mm or below high ordered, while larger items deflagrated (unless the fuze or booster were deliberately attacked).

Violent deflagration and low-order detonation. On some munitions, energetic low-order events were observed, resulting in explosive components and filling being dispersed,

which required another attack. The results of this event are potentially more dangerous than the state of the ERW as it is initially found, requiring more care to find and expose components. This situation is less likely when using explosives.

PTAB 2.5M. The nose fuze, main filling, and base detonator may react independently with up to three separate explosions heard after one attack. The longest time observed from the first to the last explosion on one event was seven minutes, but the typical period was two to four minutes. They generally low ordered as did most shaped charge munitions.

CONCLUSION

Thermite systems are a useful option for operators. There are plenty of idiosyncrasies to its use, and hopefully the points in this article will allow those using it in the future to improve safety and efficiency issues. In any country, it is probable that there will be circumstances in which thermite is not appropriate. If these issues are identified then development of further non-explosive techniques to deal with such problems will lead to operators relying less on HE. This will, in contexts such as Yemen and Syria, as well as many other places in the future, give significant benefits in terms of operational reach. Further

COMPANY	COUNTRY	CONTACT
Kareem Services Ltd	UK	kareem.dml@me.com
Burnsafe	New Zealand	martydonoghue@burnsafe.nz
Rendsafe	South Africa	info@rendsafe.com
Raikka	Finland	helsinki@raikka.fi
Disarmco	UK	info@disarmco.com

Figure courtesy of the authors.

engagement with manufacturers, development of new techniques, and support from donors should increase the effectiveness of the use of thermite. ©

See endnotes page 63

The authors would like to thank Suzanne Richards of Rendsafe and Gary Fenton of Disarmco for providing additional information.

Robert Syfret
Operations Manager
The HALO Trust, Libya



Robert Syfret joined The HALO Trust in 2015 and trained in Cambodia, Nagorno-Karabakh, and the Cote d'Ivoire before joining the Syria program. In 2016 he became Operations Manager of HALO Sri Lanka, running demining operations and assisting the expansion of the program. Syfret returned to the Syria program to design and implement a remotely-managed clearance project before completing HALO's IED Disposal course, and then working in Iraq, Yemen, and Libya. Before joining HALO, he served in the military and studied history at Glasgow University.

Chris Cooper
Capability Group
The HALO Trust



Chris Cooper is part of The HALO Trust's Capability Group. His responsibilities include assisting and developing new programs, and giving additional oversight and training to those already established programs as required. Cooper has worked in twenty of HALO's established programs over a six-year period. Prior to joining HALO, he served with the British Army for thirteen years, including time in explosive ordnance disposal.

ENDNOTES

IED Threat Consistency and Predictability in Fallujah: A 'Simple Model' for Clearance by Wilkinson [from page 7]

1. Fallujah is located in the center of the map, bordered on the west by the Tigris River. Baghdad lies approximately 65 km to the east, the direction of approach for an Iraqi Security Force advance.
2. UNMAS (Iraq) IMSMA database.
3. IMSMA is the UNMAS Information System for Mine Action and is the repository of all data and reporting on EH within (in this case) the Iraqi area of operations.
4. UNMAS (Iraq) IMSMA database.
5. Ibid.
6. Taken from: <https://iedawareness.com/2017/12/15/improvised-switches-found-in-libya/> accessed on 3 Feb 19.
7. For further details on this detector see <https://www.minelab.com/mea/metal-detectors/countermine-detectors/f3-compact>.

IEDs and Urban Clearance Variables in Mosul: Defining Complex Environments by Wilkinson [from page 13]

1. For comparison, see "IED Threat Consistency, Predictability Suggest a 'Simple' Model for Clearance."
2. United Nations Joint Analysis Unit.
3. Abu Hasan al-Muhaji, ISIS spokesperson. 18 March 2019. Message urging Sunnis in Syria and Iraq to join the "Caliphate," and the and the supporters of the group abroad are called to launch attacks on "infidels." Analysts interpret his quote, "The capital of the Caliphate, Baghdad, will never be Shiite" as an indication that the focus of the group will continue to be on Iraq. Translated read-out by UNAMI Joint Analysis Unit, Baghdad.
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More Bang for their Buck: Enhancing the Sustainability of Surplus Ammunition Destruction Programs by Farha, Krötz, and Mohammed [from page 42]

1. For the purpose of this article we follow definition of ammunition defined by the MOSAICs. Ammunition is therefore considered as „the complete round or its components, including cartridge cases, primers, propellant powder, bullets or projectiles, that are used in small arms or light weapons” including “cartridges (rounds) for small arms and light weapons; explosive shells, grenades and missiles for light weapons; and mobile containers with missiles or shells for anti-aircraft and anti-tank systems.” MODULAR SMALL-ARMS-CONTROL IMPLEMENTATION COMPENDIUM (MOSAICS). <https://bit.ly/2R2DuXh>. Accessed on 10.06.2019.
2. Small Arms Survey, "Unplanned Explosions at Munitions Sites", Accessed on 10.05.2019, <https://bit.ly/2MCuLN6>.
3. "Bamako Declaration on an African Common Position on the Illicit Proliferation, Circulation and Trafficking of Small Arms and Light Weapons Article", Accessed on 10.05.2019, <https://bit.ly/2IzFr9M>.
4. "ECOWAS Convention on Small Arms and Light Weapons, Their Ammunition And Other Related Materials," Accessed on 10.05.2019, <https://bit.ly/1wPPgSM>.
5. Central African Convention for the Control of Small Arms and Light Weapons, their Ammunition and all Parts and Components that can be used for their Manufacture, Repair and Assembly", Accessed on 10.05.2019, <https://bit.ly/2MDtuVS>.
6. "The Nairobi Protocol for the Prevention, Control and Reduction of Small arms and Light Weapons in the Great Lakes Region and the Horn of Africa". Accessed on 10.05.2019, <https://bit.ly/2K8Zy1W>.
7. "International Technical Guidelines 10.10 - Demilitarization and destruction of conventional ammunition," accessed on 10.05.2019, <https://bit.ly/2WuIy86>.
8. Elvan Isikozlu, Matthias Krötz and Claire Trancart, "Crossing the Fence: Challenges of Operationalizing PSSM," *The Journal of Conventional Weapons Destruction* 21, no. 3 (2017): 17–19.
9. As required by several international treaties, e.g., the Ottawa Convention.

Key Performance Indicators and HMA, Time to Standardize? by Evans and Hewitson [from page 46]

1. IMAS 07.14 Risk Management in Mine Action and ISO 9000:2015 Quality management systems – Fundamentals and vocabulary
2. It should not be thought that no attention had previously been paid to increasing the efficiency of survey and clearance operations or of linking mine action more clearly to development outcomes, but such efforts had not resulted in the formal adoption of methods, policies and procedures. Efforts to improve understanding of the links between the outputs of mine action and the outcomes that result are ongoing. Further efforts to explore the identification and adoption of KPIs relevant to outcomes are important but are not covered in this paper.
3. "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction," AP Mine Ban Convention, accessed 29 May 2019, <https://bit.ly/2kHbzf0>.
4. In Colombia, NGOs working to clear sites containing very low numbers of improvised landmines experienced m2/mine figures in the hundreds of square meters per mine in areas where it was possible to speak to the explosivistas who originally laid the mines as opposed to thousands of square meters in areas without access to such knowledge. [GICHD discussions as part of the Colombia landmine Ageing study]
5. As described in IMAS 07.12 Quality Management in Mine Action and 07.40 Monitoring of Mine Action Organisations
6. The question of how to encourage openness and transparency within improvement systems is fundamental to much of quality management in general. The degree to which HMA management systems are punitive, rather than supportive, impacts upon many aspects of quality and safety management as well as the way in which organizations view indicators as either helpful elements within a package of tools to help them improve, or as sticks with which they will be beaten.
7. Protocol V of the *Convention on Certain Conventional Weapons* defines ERW as either UXO or AXO. Correct reporting should reflect this important distinction, not only for reporting purposes but also to enable databases to be used as risk management tools.

Practical Notes on the Application of Thermite Systems in Mine Action by Syfret and Cooper [from page 56]

1. Patel, Divyakant (2009) "Proper Usage of Torch Systems for In-Situ Landmine Neutralisation for Humanitarian Demining, The Journal of ERW and Mine Action: Vol 13 : Iss. 1, Article 43 <https://www.gichd.org/fileadmin/GICHD-resources/rec-documents/DeflagrationPatel.pdf>. Note that the melting point of steel is in the region of 1510° (www.steelforge.com).
2. <https://www.unitednuclear.com/thermiteinfo.pdf> states "a temperature of over 3,000 degrees F°"
3. It is noted, however that the addition of aluminium to an explosive mixture will increase the heat generated on decomposition and make the mix more sensitive.
4. The Disarmco BHD8 and Dragon Mk8 documentation used as an example.
5. Costs of various systems from various manufacturers.

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Divers prepare to retrieve a bomb during an underwater demining demonstration at the 16th International Symposium Mine Action 2019 in Slano, Croatia. Photo courtesy of CISR/Amy Crockett.

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EDITORIAL: How Should We Assess New Technology?

In research and development, the challenge to secure new funding compounds the pressure of finding the next breakthrough technology in a manner that may inadvertently conflict with the development of technologies that field operators actually need. With limited funding and frequently delayed or ambiguous communication between researchers at home and practitioners in the field, are incremental improvements in equipment more practical than the development of entirely new technologies? Is it possible to work more efficiently with current procedures without loss of quality or safety? How do we encourage greater honesty and transparency in order to objectively assess new technologies and methodologies? What test and use parameters should we use to assess counter-improvised explosive device (C-IED) equipment? What pitfalls have past assessment standards suffered from and how can we overcome these issues?

The Explosive Legacy in Southeast Asia: Cambodia, Laos, and Vietnam

Multiple civil wars as well as the Indochina Wars caused extensive landmine and cluster munition contamination in Southeast Asia. With some of the densest minefields and highest concentrations of unexploded ordnance, what progress have organizations made in the region? How do operators approach the problems of remote access to many of the contaminated areas in these countries? With such extensive contamination, how do authorities prioritize which areas receive clearance efforts and how is the legacy problem hindering humanitarian relief and development across the region? Discussion of regional case studies is encouraged.

Afghanistan

As one of the most mined countries in the world, how are organizations working in Afghanistan countering legacy landmines and the removal of improvised explosive devices (IED), while incorporating community awareness and risk education into clearance operations? How are organizations adapting to clearance requirements in urban environments? What lessons can be learned from this region and applied to current conflict zones such as Syria? Discussion of current clearance programs is encouraged.

Underwater Demining

The task of surveying and clearing territorial and inland waters presents new challenges and concerns for explosive ordnance disposal (EOD) operators. Understanding the characteristics of explosives and chemical reactions in underwater environments involves extensive training. Which elements of socio-economic impact are considered before determining clearance is necessary? What types of sensor technology exist for underwater survey, and how is this technology deployed? In what circumstances are various methods of disposal practiced, and how is the risk assessed? Where is underwater demining capacity needed most, and how can national mine action authorities become certified to conduct underwater operations?

Survivor Assistance

Long-term conflicts and residual contamination in the Middle East and areas of Southeast Asia mean the number of victims and survivors of mine and UXO accidents continue to rise. In light of the steady decline in funding for victim assistance over the years, how can the mine action community translate intention into action and integrate victim assistance into wider disability frameworks?

Use of Virtual, Augmented, and Mixed Reality (XR) in HMA

How is XR being used in HMA, and what are its impacts and benefits, as well as its challenges and limits for the sector? Organizations with new XR technology are encouraged to submit.

Demining Training Aids

The onset of virtual reality and 3D printing has created new and exciting opportunities in training solutions for a variety of fields. What kind of applications does virtual reality have for EOD? In what ways has 3D printing benefited demining training purposes?

Research and Development

The Journal of Conventional Weapons Destruction seeks research and development (R&D) articles. All technical articles on **current equipment, technology, trends, and developments** in the field of mine action and CWD will be considered. Commercial companies, NGO's, and researchers are encouraged to submit. R&D articles are submitted to three experts for anonymous peer review. Two of the three reviewers must approve the article for publication. Reviewers approve articles for publication, suggest revisions or reject articles for publication.