MEASURING EXPLOSIVE MUNITIONS USE WITH OPEN-SOURCE DATA:

A New Tool for Enhancing Humanitarian Mine Action

By Jonathan Robinson [Humanitarian Researcher] and
Christoph Baade [United Nations Office for the Coordination of Humanitarian Affairs]

Since 2011, there has been widespread use of explosive weapons—including conventional weapons, improvised explosive devices (IEDs), and landmines—by all sides in the Syrian conflict.[1] As is known from other contexts, a proportion of these either fail to detonate, becoming unexploded ordnance (UXO), or are abandoned by combatants to become abandoned explosive ordnance (AXO).[2] Long after conflicts have ended, these explosive remnants of war (ERW) endure as multi-generational threats to a community's population and future development.[3]

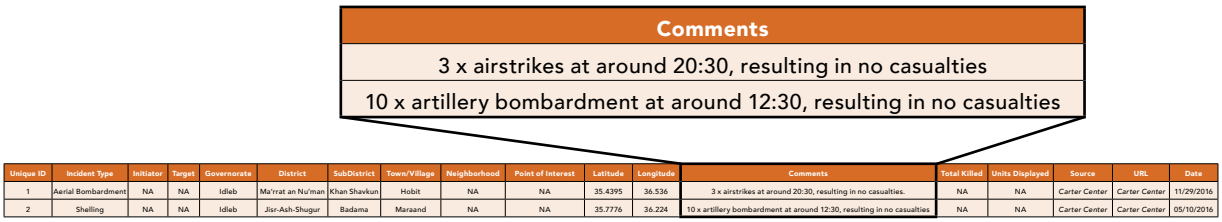
One of the first major challenges of dealing with the physical threat of ERW is assessing levels of explosive contamination in a given area. A vital aspect of this is conducting physical visits to field locations for a variety of activities, such as interviews and surveys. However, in places like Syria, this is not always possible due to insufficient access and other security, political, and financial constraints. Adapting to these challenges, many humanitarian mine action (HMA) organizations turn to desk-based, data-driven activities, such as non-technical surveys (NTS) or impact surveys, as a means to prepare for when conditions become available for conducting operations on the ground.

In 2019, The Carter Center[4] found an opportunity to engage productively via the *Explosive Munitions Use in Syria Project*.[5] Using its unique, open-source conflict dataset and an innovative method that counts the number and general category of explosive munitions mentioned within a conflict event,[6] it began analyzing and mapping information about explosive weapons use in Syrian communities. So far, The Carter Center has published four reports on southern Syria, areas around Damascus, northwest Syria, and northeast Syria. It has extrapolated 267,267 uses of explosive munitions in 2,485 communities from 63,344 reported conflict events.[7] A final report summarizing the whole of the country, including central Syria, will be released by the summer of 2021.

Not only does this desk assessment contribute to the existing body of information on explosive weapons used in the Syrian conflict, it also provides a new tool at the operational level to assist with initial planning and prioritizing actions on the ground. For example, the findings can infer the likely location[8] and general category of potential explosive hazards.[9] This can act as a basic risk assessment tool for anyone seeking to travel to an area,[10] especially HMA personnel. The study could also be used as a roadmap to help prioritize various tasks within HMA, including risk education (RE) activities and NTS, especially if other verified data is unavailable or verified data is slow to materialize.[11]

The study aims to complement existing data, data-management tools, and software, such as ArcGIS, Google Earth, the Information Management System for Mine Action (IMSMA), or Power BI. The study will be readily available in Excel/CVS file format for HMA actors to utilize for their own purposes, compare with their own datasets,[12] and temporarily fill gaps in understanding. The study would effectively augment verified data until this type of data can be collected or released, or until an on-the-ground assessment can be conducted.

At the strategic level, the granularity provided by this type of study can give political and donor entities a better understanding of the scale and complexity of the issue of explosive weapons contamination in Syria. This is especially true if the data from Syria is compared to other environments where explosive hazards clearance has taken place. The aims of the project firmly align it within key frameworks used in the HMA sector, namely the five pillars of mine action and the UN's Sustainable Development Goals.[13]



Unique ID	Incident Type	Initiator	Target	Governorate	District	SubDistrict	Town/Village	Neighborhood	Point of Interest	Latitude	Longitude	Comments	Total Killed	Units Displayed	Source	URL	Date
1	Aerial Bombardment	NA	NA	Idleb	Ma'rrat an Nu'man	Khan Shavkun	Hobit	NA	NA	35.4395	36.536	3 x airstrikes at around 20:30, resulting in no casualties.	NA	NA	Carter Center	Carter Center	11/29/2016
2	Shelling	NA	NA	Idleb	Jisr-Ash-Shugur	Badama	Maraand	NA	NA	35.7776	36.224	10 x artillery bombardment at around 12:30, resulting in no casualties	NA	NA	Carter Center	Carter Center	05/10/2016

Figure 1. Two example rows of data used in The Carter Center's *Explosive Munitions Use in Syria Project*.
Figure courtesy of Jonathan Robinson.

The Data and Method

One dataset that is particularly insightful for HMA organizations conducting desk-based assessments is verified conflict data,[14] which is typically person-confirmed, known-to-be-true information that details the type of conflict an area has experienced, the ammunition used, and the intensity of the fighting there.

While useful, verified conflict data has limitations if used exclusively. A sizable amount of other types of data may be discounted at times, especially open-source datasets and social media that have perceived accuracy or trust limitations, as the source of the information is not always clear or verified. Moreover, the process of verifying or confirming data is time consuming to do and sensitive to release in situations where conflict persists. In addition, the way current conflict data is recorded and visualized is limited; often focusing on the events themselves, rather than the information contained within them, which can show key details about the number of explosive munitions in an event.[15] This approach can lead to significant discrepancies in how explosive weapons use in an area is understood.

Taking two real examples from The Carter Center's *Explosive Munitions Use in Syria Project*, Conflict Event A records "three airstrikes" in Hobit town, while Conflict Event B records "ten artillery bombardments" in Maraand town (Figure 1). In the current system used by many HMA actors, the two conflict events would be analyzed and visualized in the same way: as two single-conflict events. However, there is obviously a significant difference in the number of explosive munitions mentioned in these two conflict events. Over time, and with a dataset of thousands of conflict events, the gulf between the number of events and the number of explosive munitions used in those conflict events grows considerably. The result is a significant discrepancy in the understanding of explosive munitions used in a given context.

The Carter Center's project aims to rectify this limitation. Between 2013 and the present day, it has collected over 200,000 corroborated conflict events from a variety of open-source outlets, including Syrian Observatory for Human Rights (SOHR), Syria Live Map, and the Armed Conflict and Location & Event Data Project (ACLED) data, as well as a small number of verified reports from the ground.[16] To the authors' knowledge, this data had not been systematically analyzed for use in the HMA sector until now.

Using this data, one of the authors developed and applied a simple method to extrapolate the number of explosive munitions mentioned within a conflict event. In cases where numbers of explosive munition uses were mentioned, these were counted (e.g., an airstrike, two barrel bombs, three airstrikes). However in cases where the number of explosive munitions were not explicitly mentioned (e.g., shelling, several airstrikes, etc.), they were given a minimum count of three. This is because single and double uses of explosive munitions were typically mentioned in the data, and so the most accurate but conservative guess for plural explosive munitions uses after this is three. This rule was used even if adjectives such as "intense" or "heavy" preceded the explosive munitions type in the conflict event (e.g., heavy shelling or intense airstrikes).[17]

Despite its limitations,[18] the study nonetheless provides a useful starting point, identifying a minimum count or baseline of explosive munitions used in a given area, from a dataset not typically employed in HMA. The data is divided into four groupings of air-launched munitions (excluding cluster munitions), ground-launched munitions (excluding cluster munitions), air and ground cluster munitions, and landmine/IED/UXO. Within each of these groupings, more details of the explosive munitions used are given, such as barrel bombing, artillery shelling, or mortar shelling, and thus can highlight the general type of hazards potentially in an area.[19] Rather than it being viewed as an exact type or number of explosive munitions used in an area, this baseline count should be seen as providing a more detailed picture about the distribution of explosive munitions over an area (Figure 2). The method does not attempt to replace verified datasets or HMA activities, but rather seeks to augment those efforts until conditions become conducive to such activities or receive such data.

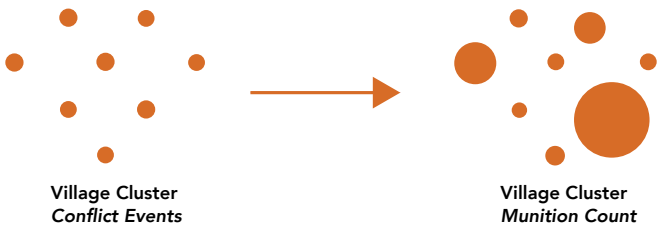


Figure 2. Current method of mapping conflict events by counting conflict events (left), and the *Explosive Munitions Use in Syria Project's* method of counting explosive munitions mentioned within conflict events provides a more detailed picture of the distribution of explosive munitions in a given area (right).
Figure courtesy of Jonathan Robinson.

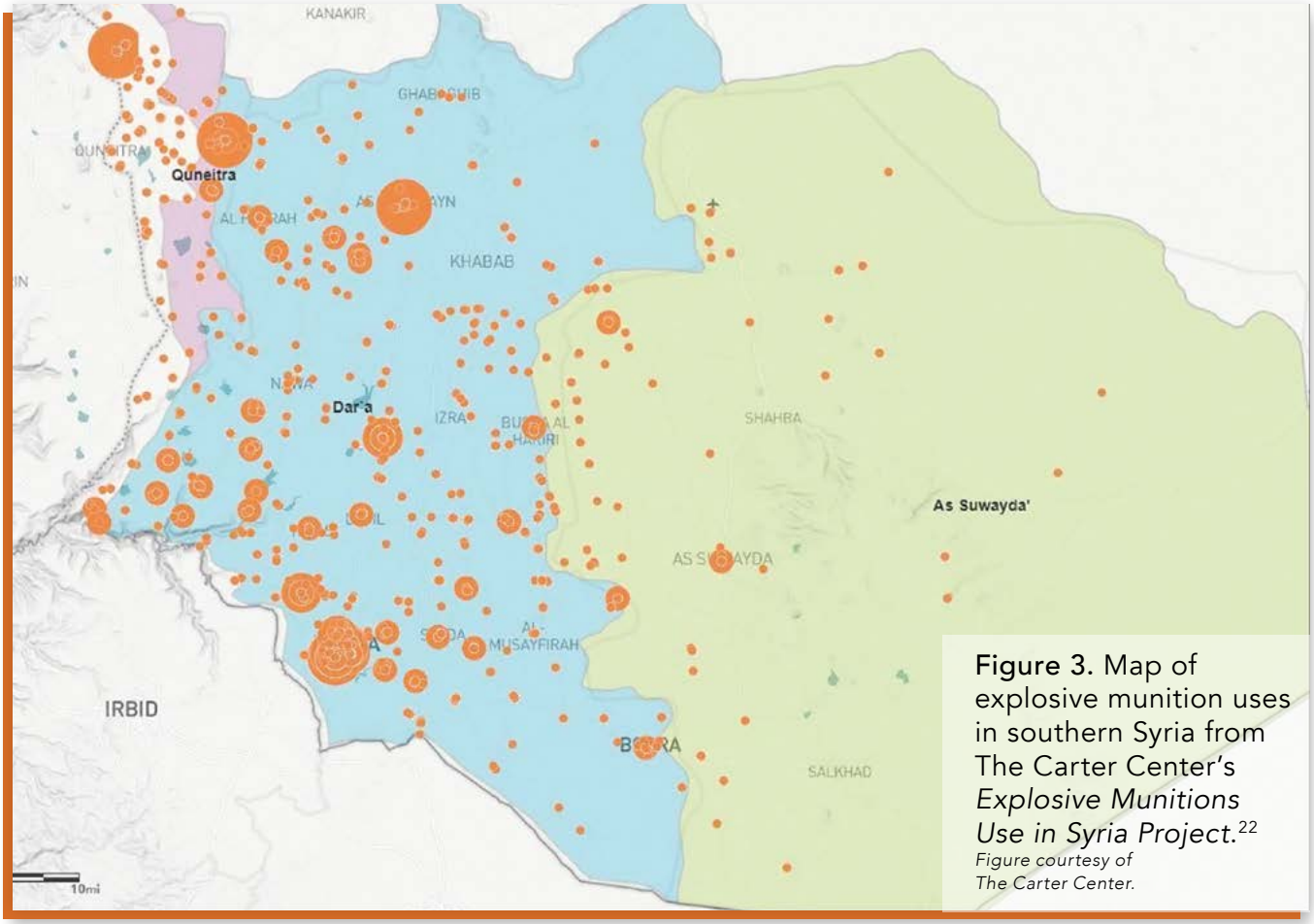


Figure 3. Map of explosive munition uses in southern Syria from The Carter Center's *Explosive Munitions Use in Syria Project.*[22]
Figure courtesy of The Carter Center.

The Technical Tool

The potential of the project is wide-ranging and is already supported by some in the HMA community.[20] At the operational level, the project functions as a basic risk assessment tool for initial planning stages and prioritizing HMA activities for actors traveling to a potentially contaminated area.[21] Another use could be to help initially plan NTS and RE activities in a more systematic way, given that the findings cover the distribution of explosive munitions across Syria (Figure 3).

At the strategic level, the study can aid political and funding advocacy efforts by better highlighting the scale and complexity of the issue as well as an estimation of the significant resources required. For example, if a percentage of between 10 percent and 30 percent[23] is given as the number of items that failed to detonate and applied to the 267,267 explosive munitions used in The Carter Center's studies so far, this suggests that between 26,727 and 80,180 explosive munitions are present in communities identified in southern Syria, areas around Damascus, northwest Syria, and northeast Syria.[24] Although it would not provide an exact dollar amount or hours needed for the clearance of UXO in Syria, comparative analysis of estimated contamination levels, clearance rates, and the geographical size of contaminated areas with regions such as Iraq or Mozambique[25] could go some way to creating a tangible reference into what is minimally required to deal with the UXO problem in Syria.[26]

Wider Applications and Future Outlook

Looking to the future, while the current study is applied to Syria, its methodology easily lends itself to other environments where HMA activity is needed or conducted, given that this type of project only requires open-source conflict data as an input.[27] Not only this, other information could supplement the open-source data to strengthen the inference of explosive weapons use and potential contamination, including other open-source conflict datasets, open-source data on explosive munitions clearance, satellite imagery detailing explosive munitions damage, weather conditions during the events, information on how long communities remained under the control of an armed group, or the time a community spent close to a frontline to name a few (Figure 4).

Artificial intelligence (AI) and machine learning (ML) could also be used to extract information about explosive munition uses

from visual (video and photo) or text media from a wide range of sources, including social media tools like Twitter or Facebook. AI and ML would also improve the speed and efficiency of the project; instead of manually extrapolating the explosive munition counts from each conflict event, it could be done automatically.

The additional layers of information mentioned previously are by no means exhaustive, but could result in unprecedented findings on the validity and utility of open-source data and its usefulness in the HMA sector. As mentioned previously, rather than replace existing methods and systems in the HMA sector, the study would seek to augment these in cases where conditions are not available for HMA actors to obtain firsthand verified data from the ground and act as an initial phase of the desk assessment.

Used intelligently, open-source data could support different purposes outside of the HMA sector as well. For the peacebuilding sector, HMA and open-source data studies can be used as an entry point for convening and conducting initial practical discussions between sides in a given context, as the topic of dealing with explosive munitions contamination is relatively neutral and is a problem that people often unanimously agree needs solving.[28] If successful, HMA and open-source data studies could then be used to build discussions on wider topics, such as humanitarian access issues, housing, land and property rights, or good governance. Examples of HMA being successfully implemented in peacebuilding initiatives have been seen in Armenia, Azerbaijan, Colombia, Sri Lanka, and Sudan.[29]

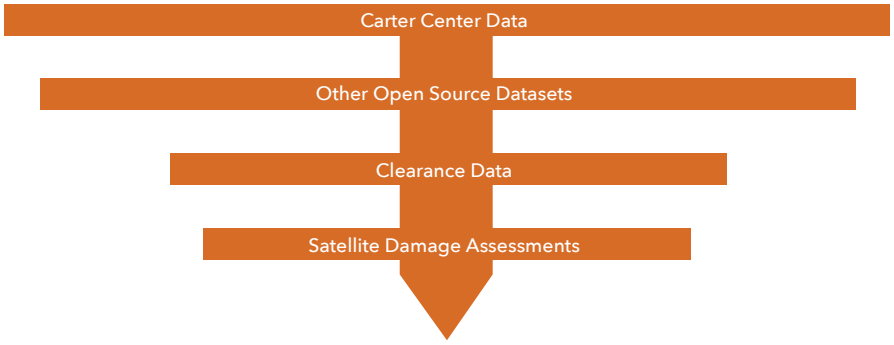


Figure 4. Different layers of data that could improve the results of the *Explosive Munitions Use in Syria Project*.
Figure courtesy of Jonathan Robinson.

Conclusion

By using open-source data and a method that counts explosive munition uses rather than conflict events, a detailed overview can illustrate the distribution of a variety of types of explosive munitions in a given area. This can give actors conducting initial desk-based assessments an advantage if other methods are ineffective or unavailable. This tool can be used to conduct a basic risk assessment for HMA actors, as well as add to HMA actors' ability to plan and prioritize activities over a large area, such as NTS or RE activities. At the strategic level, the granularity provided by this type of study can give political and donor entities a tool that helps contextualize and appraise the scale and complexity of the issue of explosive weapons contamination in an area, especially if used comparatively with other contexts. Not only limited to Syria, the project has strong potential in a number of other locations around the world, such as Libya, Ukraine, and Yemen as well as in neighboring sectors such as peacebuilding. The authors hope that this article encourages other entities to replicate this study in the future with their own conflict data to supplement their existing methods or datasets.

With the completion of The Carter Center's project expected by the summer of 2021,[30] the authors are actively seeking collaboration with entities seeking to replicate or widen this scope of the project, especially in other regions in the world.[31] We would also welcome any feedback about the project.

The views expressed in this article do not represent the authors' current or previous employers.

BIOGRAPHIES

Jonathan Robinson
Humanitarian Researcher

Jonathan Robinson is a humanitarian researcher specializing in data and its application in humanitarian mine action. He previously led The Carter Center's *Explosive Munitions Use in Syria Project*, as well as supported Caritas Switzerland, The HALO Trust, and the International NGO Safety Organisation (INSO) among other organizations in the Middle East over the past ten years. Robinson holds a masters of science from the University of Edinburgh and a bachelor of arts (hons) from Durham University.

Christoph Baade
Consultant
UN OCHA's Central Emergency Response Fund

Christoph Baade specializes in conflict research and its application in humanitarian mine action and peacebuilding. He is currently a consultant at UN OCHA's Central Emergency Response Fund. He previously supported The Carter Center's *Explosive Munitions Use in Syria Project* and worked as a research consultant at ArtEZ Institute of the Arts, The Netherlands. Baade holds a master of arts from King's College London and a bachelor of arts degree from Leuphana University of Lüneburg.

ENDNOTES

Measuring Explosive Munitions Use with Open Source Data: A New Tool for Enhancing Humanitarian Mine Action
By Jonathan Robinson [Humanitarian Researcher] and Christoph Baade [United Nations Office for the Coordination of Humanitarian Affairs]

1. Human Rights Watch (HRW), *Explosive Weapons Devastating Civilians: International Action Needed to Curtail Deaths, Long-Term Harm in Populated Areas* (Feb 2020). Accessed from https://bit.ly/3k8WuUu. on 1 May 2020.
2. Geneva International Center for Humanitarian De-mining (GICHD), *Explosive Remnants of War (ERW) Definitions* (Nov 2001). Accessed from https://bit.ly/3z7MhM0.
3. Action on Armed Violence (AOAV), *The Reverberating Effects of Explosive Weapon Use in Syria* (Jan 2019), Page 4. Accessed from https://bit.ly/2YTXiUY.
4. The Carter Center is a nongovernmental organization guided by the principles of Founders Jimmy and Rosalynn Carter. Founded in partnership with Emory University, on a fundamental commitment to human rights and the alleviation of human suffering, The Carter Center has helped to improve the lives of people in more than eighty countries by resolving conflicts, advancing democracy and human rights, preventing diseases, and improving mental health.
5. The *Explosive Munitions Use in Syria Project* is run by the Syria Conflict Mapping Project, part of The Carter Center's Conflict Resolution Program on Supporting Peace in Syria.
6. As opposed to the common practice of counting the conflict event itself, which can contain multiple explosive munition uses.
7. The Carter Center, *Explosive Weapons Contamination in Syria, Report 1; Southern Syria: As Sweida, Daraa and Quneitra Governorates (Nov 2019)*, The Carter Center, *Explosive Weapons Contamination in Syria, Report 2; Damascus and Rural Damascus (Jan 2020),* The Carter Center, *Explosive Weapons Contamination in Syria, Report 3: Northwest Syria: Aleppo, Idleb, and Latakia Governorates (Aug 2020),* and The Carter Center, *Explosive Weapons Contamination in Syria, Report 4: Northeast Syria: Al Hassakeh, Ar Raqqa, and Deir Ez Zor Governorates (November 2020).* Accessed from https://bit.ly/3Ecb05G and
8. Although it is understood that the data study alone cannot fully predict explosive weapons contamination as a variety of conditions are needed for the formation of this such as firing conditions, weather, ground type and age of munitions (to name some).
9. These weapons types are general such as air launched, ground launched shelling, rather than specific weapons manufacturers. It is also understood that a variety of factors contribute to the formation of explosive weapons contamination, not just where high levels of bombardments have occurred.
10. The advantage of the study being that the distribution of explosive munitions is focused on rather than the exact number of items in it.
11. Given that it takes considerable time and effort to verify or confirm an event or munition use.
12. For example, the data from the project could identify and establish suspected hazardous areas (SHA) polygons which could then later be entered in IMSMA and followed up by non-technical surveys.
13. As the project helps; 1) assist in raising awareness and prioritization of potential high risk areas of UXO contamination in Syria for risk education, 2) assist with prioritizing areas for on the risk mitigation activities and ground surveys as part of the initial stage of mine action, 3) support advocacy efforts in the de-mining sector and donor levels, 4) bring together key decision makers from all sides of a conflict, 5) highlight the need for an effective long term policy response and 6) contribute to reducing the threat posed by explosive munitions and the lasting impact it has to people living in affected areas.
14. For example, IMMAP, *The Mosul Dashboard: Explosive Incidents* (Oct 2016). Accessed from https://bit.ly/3huWZGt.
15. For example, Humanity and Inclusion (HI), *The Use of Explosive Weapons in Syria; A Time Bomb in the Making* (May 2015). Accessed from https://bit.ly/3ljXJPT.
16. The Carter Center's reports explain more about the data used. See The Carter Center, *Explosive Weapons Contamination in Syria, Report 2; Damascus and Rural Damascus (Jan 2020), Page 3. Accessed from* https://bit.ly/2YIOhOk.
17. For more details about this method, see The Carter Center, *Explosive Weapons Contamination in Syria, Report 2; Damascus and Rural Damascus* (Jan 2020), Page 3 - 4. Accessed from https://bit.ly/3CapDF0.
18. Such as with the limited accuracy and trust of open source data, and the method likely under-counting the number of explosive munitions in a given conflict event, especially if no exact number of munitions was given.
19. This is as detailed as the study goes. It does not specify the exact weapon type used or manufacturer. For more information please see the aforementioned Carter Center reports.
20. The study was presented to members of the UNMAS Humanitarian Mine Action Syria Working Group in Amman on 15 September 2019 after being invited to do so. This built on a proof of concept study focused on Eastern Ghouta and in Yemen in 2018 conducted by one of the authors. In addition, at least 8 HMA actors focused on Syria have expressed interest in using the findings and method of the project for their work in Syria. Two HMA actors are currently testing the validity of the findings in their activities on the ground, while one has built in the method outlined in this project to enhance their own desk assessment process.
21. The advantage of the study being that the distribution of explosive munitions is focused on rather than the exact number of items in it.
22. Map from The Carter Center, *Explosive Weapons Contamination in Syria, Report 1; Southern Syria: As Sweida, Daraa and Quneitra Governorates* (Nov 2019), Accessed from https://bit.ly/2XcJvbH.
23. A reasonable assumption based on previous studies such as RAND Corporation, *Unexploded Ordnance Clean Up Costs; Implications of Alternative Protocols*, (2005), Accessed from https://bit.ly/3npvIZX.
24. With this count likely much higher given the limitations of the data, methodology and way UXO is formed.

25. Partly available from open sources.
26. This is in addition to various issues such as lack of international appetite for funding in government areas of Syria, sanctions and terrorism laws applied to Syria, and limited access into the country and within for entities that conduct de-mining.
27. Such as Ukraine, Libya or in Yemen, where one of the authors conducted a pilot version of the explosive munitions project with Halo Trust in late 2018.
28. As The Carter Center did in January 2020 and mentioned in the following source The Carter Center, *Using Conflict Data to Help Demining Efforts in Syria (Aug 2020*), Accessed from https://www.cartercenter.org/news/features/p/conflict_resolution/using-conflict-data-for-demining-in-syria.html on 30 January 2021.
29. This often underutilized field was developed in the early 2000s from contexts in the 1990s, before being further enhanced in the mid 2010s. Two key reports on this topic that contains numerous examples of HMA being used in peacebuilding are 1) Geneva International Center for Humanitarian De-mining (GICHD), *Mine Action and Mediation* (Oct 2016). Accessed from https://bit.ly/3ht2s0m 2) International Peace Research Institute (PIRO), *Preparing the Ground for Peace – Mine Action in Support of Peace Building* (Feb 2004). Accessed from https://bit.ly/3lkFUAb.
30. The completed project will span five reports and visualize and analyze a dataset of hundreds of thousands of explosive munitions uses extrapolated from tens of thousands of conflict events. This will cover thousands of communities in the 14 governorates of Syria from July 2013 until the present day. This data will be freely available from The Carter Center Syria Program on request. The Carter Center is expected to regularly update the dataset in the future as part of a routine maintenance of the project to keep it relevant.
31. They are currently seeking to develop a pilot project in Ukraine, develop other information layers to be used in the project as well as its wider use in the peacebuilding sector.