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FEATURE

DRONES SUPPORTING MINE CLEARANCE IN NORTHERN SRI LANKA

by Oliver Gerard-Pearse [The HALO Trust]

The humanitarian mine action (HMA) community's nascent adoption of commercial drone technology has no doubt made a positive impact within the sector. However, drones go underutilized in HMA and many opportunities as well as potential pitfalls remain.

Nurturing and developing this technology to assist in an increasingly diverse and evolving industry will benefit the community greatly. However, drones have only recently drawn the public eye with considerable strides forward in developing technology that is now available and financially accessible to the general public. Popular commercial brands are appealing more to the budding photographers and video bloggers that are able to achieve a professional angle in photographs or videos.

This article reviews the opportunities and associated challenges that drones present to the HMA sector before presenting a case study of drones used to support mine clearance in Sri Lanka to clear the densely-laid Muhamalai minefield. It concludes with recommendations for the implementation of drones in other HMA programs.

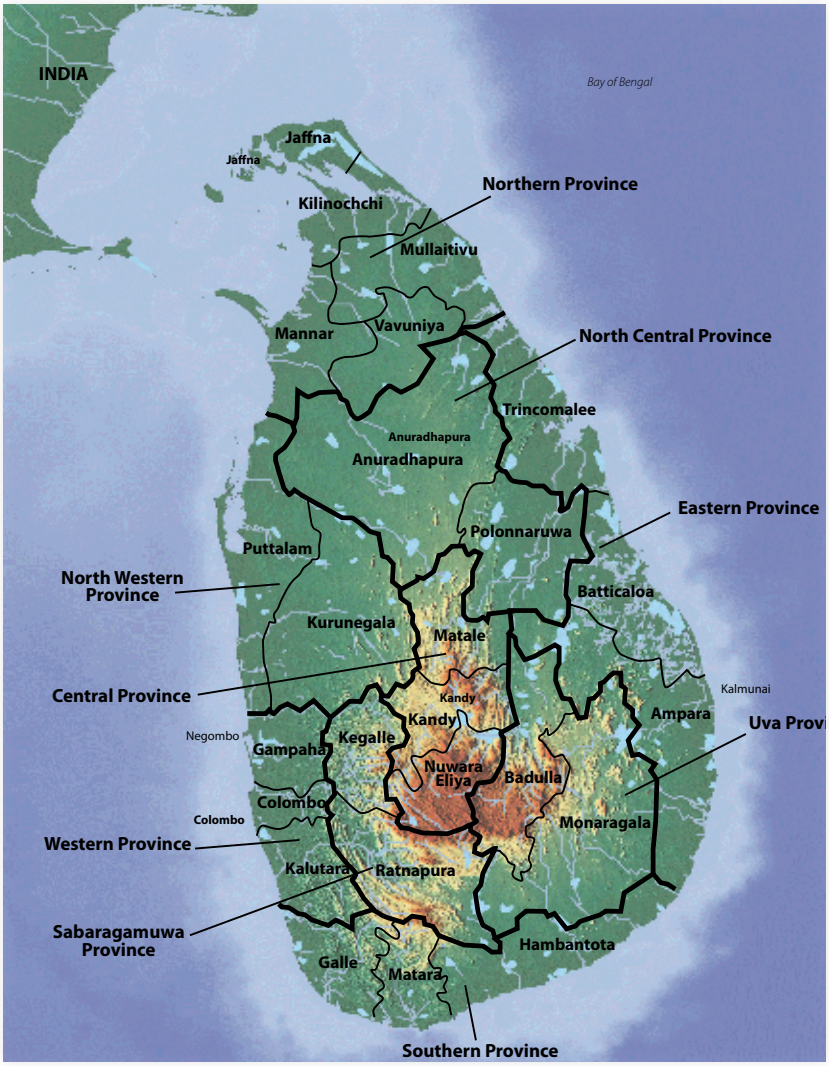

Figure 1. Map of Sri Lanka.
Map courtesy of CISR.

Drones in Conventional Mine Clearance: Challenges and Opportunities

With the rapid increase in drone popularity and general use, many governments have struggled to produce formal legislation regarding the parameters in which the machines may be used, some presenting restrictions, limiting any practical use at all. In contrast, others have yet to acknowledge the requirement for such regulations. In post-conflict countries, even the word drone may prompt skepticism, however, generally the use of small commercial drones is allowed.

Currently, there are no formally developed national or international standards for the use of drones in mine clearance operations. However, a number of concepts have been developed to assist directly in detection and mapping tasks within some mine contaminated environments. This technology, although not used widely in the sector, has the clear

Figure 2. A hand-drawn sketch map of the cleared areas within HALO's area of operations. Yellow marks manual clearance and green marks mechanical clearance. The scale is 1 cm = 20 m.
Image courtesy of The HALO Trust.

potential to develop and aid in the clearance of landmines and explosive remnants of war (ERW) in the near future. With the support of the U.S. Department of Defense Humanitarian Demining R&D Program, The HALO Trust (HALO) has been using standard commercial drones in their programs around the world for a number of different tasks. These include high-resolution videos for communications and fundraising, training videos, and imagery for donor reporting purposes.

While drones certainly have advantageous uses in HMA, they are not without their drawbacks. First, due to political instability and ongoing conflict in some countries, the use of drones is not possible. Second, with standard drones, battery life and the subsequent flight range is quite limiting. Flying in areas or conducting tasks that require a drone to be airborne for longer than 20 minutes is just not possible. However, this can be avoided in most cases through careful planning.

Figure 3. A georeferenced orthomosaic created when using the drone to map large areas. 701 photos have been merged into one. Cleared mines are displayed as red (anti-personnel mines) and blue (anti-tank mines) dots.
Image courtesy of The HALO Trust.

Case Study: Drones Supporting Mine Clearance in Sri Lanka

HALO's program in northern Sri Lanka increasingly relies on drones to manage the clearance of the biggest and most complex minefield the organization is currently working on: the Muhamalai Forward Defensive Line. Muhamalai in Killinochchi District, Northern Province saw eight years of fighting over a 10.5 sq km (4.1 sq mi) strip of land connecting Jaffna, Sri Lanka's most northern district, to the rest of the country. Dense mine lines were laid by the Sri Lanka Army (SLA) and the Liberation Tigers of Tamil Eelam (LTTE) that today, nine years on, are stopping hundreds of displaced people from returning home.

Clearance of this area first began in 2011, spearheaded by HALO, with initial operations aimed at clearing the main A9 highway connecting Jaffna to Colombo. Quickly after public access was created, the railway line that had been destroyed during the war was repaired, and a sense of normality began to seep back into the region.

The Muhamalai minefield has been split up into manageable sections based on ground features and previously known tracks. The National Mine Action Centre allocated the majority of these sectors, 6.5 sq km (2.5 sq mi), to HALO with national NGOs, Delvon Assistance for Social Harmony (DASH), Skavita Humanitarian Assistance and Relief Project (SHARP), and the SLA being allocated the remaining area to clear.

On-site Challenges

Two large villages exist within the mine field. During the conflict, these villages were vacated, the infrastructure was destroyed, mines and improvised explosive devices (IED) were densely laid, and there was significant crossfire that also contaminated the land with unexploded ordnance (UXO). The humanitarian requirement is immense. While many

Image 3. The monthly operations planning meeting. Drone pictures are used as key planning tools.
Image courtesy of The HALO Trust.

displaced families have been in refugee camps or seeking shelter with relatives for over a decade, the people of Northern Sri Lanka can rebuild their homes in a matter of weeks once land is cleared and released. For this reason, good management and prioritization of clearance to target those resettlement areas is essential.

Currently, HALO deploys 465 staff in 45 manual and 10 mechanical teams over 6.5 sq km (2.5 sq mi) of Muhamalai. Planning, managing, and successfully implementing the deployment of 465 staff across such a large area presents multiple challenges and complexities. In addition, clearance in Muhamalai is arduous due to the extreme levels of metal contamination ranging from large UXO to small metal fragments of exploded armored vehicles. As a result, the use of metal detectors is not possible and the entire area requires full excavation by manual or mechanical means.

Implementing Drones

Over the past year, HALO's operations management team have found several uses for drones in Muhamalai. First, HALO uses drones to monitor progress and assist in planning for the deployment of the clearance teams—in particular for its 10 mixed-asset mechanical teams. The nature of mechanical mine clearance demands constant adaptability as clearance progresses. The terrain, vegetation levels, and explosive threats constantly change, requiring the use of different bucket types, processing methods, assets, and so on. Real-time aerial photography identifies obstacles or difficult areas that informs and supports the deployment of remote-controlled machines as well as their ability to monitor the time and motion of multiple machines when safety distance rules make this otherwise impossible.

Second, free mobile apps such as Pix4D Capture are being used to remotely control the drones and accurately map out large areas by taking photographs at set intervals to create detailed, georeferenced orthomosaic images. The fully-processed composite image can then be developed using GIS software to show the locations of all mines and ERW found in the area. This is especially useful when analyzing the potential for reduction, which is a key element of the land release process.

Third, HALO uses drones in Muhamalai to meet its monitoring and evaluation commitments. Identifying clear targets and quantifiable outcomes that can be broken down using inputs into a logic model are essential to the reporting process. Google Earth is an excellent free resource that provides accurate imagery and allows minefield polygons to be layered onto a satellite imagery base layer with linked survey and clearance information. It does, however, lack detail of the ground and is not updated regularly. While all socioeconomic surveys require surveyors to physically visit former minefields and ask respondents how their living situation has changed, drones can aid monitoring and evaluation professionals to gain a more accurate understanding of land use on former minefields. For example, drone imagery can be used to measure and georeference the size and location of land being used for post-clearance agriculture.

The ability to use drones as a pre-clearance mapping tool is always likely to be vegetation dependent, but in areas of low-density vegetation, HALO has found drones to be extremely useful for operational planning and clearance analysis. Post-clearance, drones support reporting requirements and monitoring of post-clearance development, providing the donors who fund the clearance activities with the most up to date imagery of exactly where and how their money has had a positive impact on the local population and the economy. Further to this, they are an excellent resource for training

A Case 721C Wheel Loader drops contaminated soil in a marked inspection lane. Aerial photos enable proactive deployment into areas that are best suited for certain assets.
Images courtesy of The HALO Trust.

The PrimeTech PT-300 D:Mine tiller. Aerial photos enable proactive deployment into areas that are best suited for certain assets.
Image courtesy of The HALO Trust.

and demonstrations, which are key components for development in HALO's workforce and operational capacity.

Future Uses for HMA

With the international focus shifting quickly away from conventional, legacy mine clearance to the new unknown of high-risk clearance of IEDs, the requirement for real-time remote-management tools has increased significantly. Confirmed hazardous areas (CHA) containing large amounts of rubble require mechanical clearance of items with high-explosive content, and demand much larger safety distances and a much more precise and targeted clearance approach. Here, drones have the potential to provide excellent imagery that can be used by machine operators or explosive ordnance disposal (EOD) technicians to create a 3D view of the working area, highlighting obstacles or objects that would not otherwise be visible.

Some operators already use drones to monitor safety cordons for demolitions and disposals, especially low-order techniques (e.g., monitoring a burn to see when it is safe to return), but there is definitely scope for this to become best practice. In an operational environment where exact clearance techniques are still being developed and identifying the threat is key, any additional reconnaissance and search tools could prove extremely valuable.

Drones have proven to be an effective supporting tool to HMA clearance in northern Sri Lanka and with further developments in the way of extended battery life and more advanced camera systems, this capability will only increase. Across the sector, with further input from operators, drone technology has the potential to become a standard component of HMA programs around the world.

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