Journal of Conventional Weapons Destruction

Volume 2
Issue 1 *The Journal of Humanitarian Demining*

Article 4

December 1998

Current Situation and Perceived Needs for Head and Face Protection in Humanitarian Demining

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The Journal of Humanitarian Demining

Article

Current Situation and Perceived Needs for Head and Face Protection in Humanitarian Demining

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Winter, 1998
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The safety equipment used in humanitarian demining in developing countries would be considered inadequate by any Western army engaged in combat demining or explosive ordnance disposal (EOD) work. No set of standards is imposed and the standards that have arisen are surprisingly low. There is no widely accepted need for better protective equipment, but demining organisations do seem to be slowly levelling-up in the equipment that they use. Very few demining groups routinely wear hel

mets. Those demining groups that are concerned about head protection usually favour a 30cm high full-face visor hanging on a head-harness (or head-frame). The visor provides some protection to the throat as well as to the side of the head.

Figure 1: HALO Trust deminer in Cambodia, wearing 5mmpolycarbonate visor.

In this paper I present an overview of the current situation in humanitarian demining, explain how it has arisen, and then summarise the arguments that are used to justify it. I go on to identify the standards that are evolving, and suggest

design requirements for the provision of equipment best suited to meet the perceived needs.

1. Current equipment provision and United Nations standards

Humanitarian demining is usually carried out by groups of indigenous deminers who use Standing Operating Procedures (SOPs) and equipment that are hurriedly adopted when their group starts to work in the country. Demining groups, whether commercial, UN-backed or charitable non-government organizations (NGOs), are usually managed by soldiers drawn from the armed forces of UN member countries, or ex-soldiers drawn from the growing pool of experienced demining organisers (offering their services at commercial rates). With management sharing similar backgrounds, it is not surprising that humanitarian demining practice does not vary a great deal around the world. Below follows a brief summary of the demining process, undertaken after the extents of the mined area have been decided and work has begun.

1.1 Summary of the manual demining process

Undergrowth is usually removed by hand as the deminer progresses, although mechanical means of removing undergrowth in advance of the deminer are beginning to be used (examples are HALO Trust in Cambodia, Menschen gegen Minen MgM in Angola, and Mine-Tech in Bosnia). With the undergrowth removed, mines and ordnance are located by eye or by using a metal detector whenever possible. When that is not possible, mines are detected by prodding the ground with a probe. If the ground is too hard, the ground is scraped rather than probed, as is common practice in highland Afghanistan. * Prodding and probing are generally carried out in a kneeling (or on one knee) position. This is true even when the official SOP of the group requires that the activity be carried out lying prone. When a mine has been detected it is carefully exposed. Most groups expose just enough to identify the mine and lay a charge beside it. Some groups, such as Norwegian People's Aid (NPA), Compagnie Francaise d'Assitance (COFRAS), and Conseil International de Development (CIDEV), routinely expose the whole mine, lift it with a small grappling hook from a safe distance to check for booby traps or smart fuses, then defuse the mine for destruction later. ** In most cases common unexploded ordnance (UXO) is dealt with routinely by field personnel, although most groups have an ex-patriot EOD man who can be called in to deal with unknown or damaged finds.

1.2 High-risk times

Every specialist in the field has an opinion over when the greatest risk of

injury occurs and many of those opinions conflict. For example, one may say that laying the charge beside a mine is a time of high-risk, while another will say that it is a time of high concentration, so low-risk. No comprehensive study of accident data has been made, and (in my experience) accident data are often recorded in a way that would not facilitate such a study. From my field research, I believe there are two main times when a deminer is at risk. These are when walking in an area believed to be safe and when probing to investigate a detector signal (or probing when a detector cannot be used). The first should never happen and only full body armour would offer some protection, although the blast would still result in serious injury. The second high-risk time is of greater concern, because it is taken during a necessary part of current procedures. Most deminers are kneeling at this time, although some are lying prone. Those who kneel tend to say it is more dangerous to have your head close to the blast epicentre (because ear and brain damage can occur even if wearing a helmet). Those who lie prone tend to clutch their genitals at the thought of kneeling. The real reason for the prevalence of kneeling is comfort: deminers may spend hours probing in any one day and this makes their comfort a major issue.

1.3 UN standards

Having started in most areas as a response to a humanitarian emergency, demining is often only funded in the short term. Aid agencies, other NGOs and the UN may all move into an area without any coordination or long-term strategy. In Cambodia, Mozambique, Angola and Afghanistan, it has become the UN's role to act as coordinator, even though they often lack the authority to control the activity of those demining groups they do not fund. They seek to establish a working system, with SOPs, conditions of employment, and insurance, which the national government can take over as soon as it is able. The ability or willingness of national governments to take over demining with largely humanitarian aims cannot be guaranteed. Those governments may have another agenda, especially after the high priority areas, such as roads, power lines and industrial areas have been made safe. In Cambodia, the Cambodia Mine Action Center (CMAC) is well established and technically independent of both the UN and the national government. In fact, the UN and other groups provide technical support and the UN effectively monitors the funding, probably because outside donors do not trust the Cambodian government to do so. In Mozambique, the best that can be said of the government agency (Mozambique National Mine Clearance Commission, also known as the CND) established to take over from the UN Accelerated Demining Programme (UNADP) is that it is "not dynamic" at present. In Angola, the Angola National Institute for the Removal of Explosive Ordnance (INAROE) and Central Mine Action Office (CMAO) look like they may develop into another CMAC, the national government having wholly other priorities. In Afghanistan,

the United Nations Office for the Coordination of Humanitarian Assistance to Afghanistan (UNOCHA) based in Pakistan's Islamabad started from a different base. It was established to coordinate the activities and funding of Afghan demining groups that already existed and has never been directly involved in demining itself or involved Afghan government staff in its management. Nonetheless, it dictates SOPs and equipment standards to the groups it employs.

Most observers would agree that it should be the UN's role to impose minimum standards in humanitarian demining activity, so protecting the impoverished recruit to demining from unnecessary dangers or exploitation. Unfortunately, the UN has not been effective at agreeing on (never mind establishing) standards across the industry. That statement could be justified with examples of the discrepancy between any UN recommended demining standard and the field practice of UN teams. In this context, I will limit my discussion to the UN published standards for head, face, and eye protection.

The UN publishes International Standards for Humanitarian Mine Clearance Operations, at http://www.un.org/Depts/Landmine/Standard/s-index.htm.

In paragraph 1.5 of this document, the UN minimum standards for "Personal Protective Equipment" are given as "eye protection and a jacket," with the standards for the former quoted below.

> **a) Eye Protection and Helmet. Eye and face protection is to be provided by the use of a fragmentation visor. The visor must meet the minimum standard of personal protection which is to be capable of withstanding a V50 rating (dry) of 450m/s for a 1.102g fragment (refer to STANAG 2920).... A helmet should be worn unless it compromises the safety of the operator. It must conform to the same protection standards as the visor.**
>
> **b) Safety glasses. When used, safety glasses must be able to meet the minimum standards of personal protection and be capable of withstanding a V50 rating (dry) of 450m/s for a 1.102g fragment (refer to STANAG 2920)...**

1.4 Use of Helmets

Of the UN demining organisations in developing countries that I have visited (Cambodia, Pakistan/Afghanistan, Angola, and Mozambique), only one requires the wearing of a helmet (UNOCHA, Islamabad). UNOCHA is currently considering a change to full face visors without helmets in response to a request from Afghanistan Technical Consultants

(ATC), their biggest Afghan contractor. A few demining NGOs wear helmets with a visor attached. The most well known of these is the British NGO Mines Advisory Group (MAG). At the time of writing, MAG deminers probing for mines wear a laminated aramid helmet with an estimated V50 of 610 m/s. MAG has been considering changing to full- face visors without a helmet since at least August 1996 and may yet decide to change; however, by December 1997, MAG has not implemented the change.

1.5 Eye and facial protection

Most groups around the world wear industrial safety spectacles while in a mined area. In many cases, these safety spectacles are the only protective equipment issued. The UNADP in Mozambique now issue their deminers with low-grade industrial safety spectacles with an estimated V50 of well under 100m/s and which are reported to have failed their own crude 1995 in-house test (200g TNT detonated one meter from the spectacles).

The UN in Angola issued 5mm polycarbonate visors with a V50 of around 280m/s and these continue to be used by their successor/progeny CMAO. These visors are also used by HALO Trust and helmet visors of the same thickness are used by MAG (although the manufacturers of MAG's helmet visors claim a suspiciously higher V50).

The UN-supported/advised group CMAC in Cambodia is in the process of changing to using 4.5mm polycarbonate visors (locally made) with a V50 of around 260m/s, industrial safety spectacles (with an estimated V50 of 100m/s) over several years.

The UNOCHA in Islamabad (controlling Afghan demining groups) imposes a standard with a military helmet and 3mm polycarbonate visor (under 200m/s). The difference in protection offered by the helmet (610m/s) and the visor in this case is particularly absurd.

Another major player in the field, NPA, issues 5mm polycarbonate full-face visors in Angola (280m/s), but industrial safety spectacles in Mozambique. (NPA Mozambique expressed interest in sourcing 5mm visors from Zimbabwe in February 1997, but nothing has come of that at the time of writing.)

From the above it can be seen that no demining organisation in the developing world imposes the minimum standard for face protection that the UN recommends. It is worth mentioning that very few of theses demining organizations use the minimum body protection recommended either (no UN groups).

Of the NGOs in demining, the British HALO Trust and MAG use protection that comes closest to the requirement, but their visors do not reach the standard. I have encountered demining specialists who are surprised to hear that the 5mm polycarbonate visor does not provide good protection against grenade and POMZ fragments. The specialists had been misled by the sales literature of UK suppliers that refers to them as "fragmentation" visors. In my experience, they are very effective at stopping blast and environmental fragmentation from large explosions (up to 2.5Kg at 1 meter) but are less than reliable * against metal fragmentation. They have proved very effective against a range of blast mines but have been damaged (although not holed) by casing fragments from bakelite PMNs and MAI-75s. Accordingly, I refer to them as "Blast visors."**

It is disturbing to note that the lowest protection standards anywhere are those imposed by UNADP in Mozambique. Also, there is no uniformity in UN equipment from country to country, much less continent to continent, and the standards in use seem to be adopted without reference to what the UN itself publishes. In case this paper should appear to be singling out the UN for criticism, I should emphasise that the UN in Angola have established standards of face and head protection equal to those used by any other group in humanitarian demining. The UN in Cambodia is also improving standards (against CMAC deminer resistance) for which it deserves significant credit.

2. Why the standards are so low

Humanitarian demining in developing countries bears little resemblance to combat demining by troops from the developed world. Even so, the difference in protection offered by the safety equipment requires some explanation. Reasons that have arisen during my research can be grouped under two headings: difference in working methods and difference in culture and economic setting.

2.1 Difference in working methods

The most obvious difference between humanitarian and combat demining is that humanitarian deminers are not under threat from hostile fire (humanitarian demining only takes place with the agreement of all interested parties). Also, the deminer does not have to work under extreme weather conditions (they often work in extreme heat, but are usually prohibited from working in wet conditions). Other differences between humanitarian and combat demining are that (1) deminers only work in daylight; (2) deminers carry out the same tasks day after day for up to 8 hours (usually 6); (3) when a device has been found, deminers are not generally under pressure to work quickly to deal with it; (4) demining is overt rather than covert, so noise can be made; and (5)

deminers work at a distance from each other (usually the SOP states 25m or more, but 15m is common practice).

Unlike the combat deminer working under pressure to clear a passage, the humanitarian deminer has to find every mine and piece of ordnance over a wide area. The quality assessors frequently demand that every piece of metal is removed from a cleared area, making it easy to check with a detector that the work has been done. This makes the work slow and means that one cannot simply avoid a thicket or dense undergrowth, canal or ruined building. Every signal must be investigated and days can pass without a single device being found. Some individual deminers I have interviewed have not found anything for weeks. In these circumstances, it is not pressure and adrenaline that cause problems but the lack of concentration that comes from boredom. Deminers can be easily distracted and some argue that the discomfort associated with protective equipment would be such a distraction. Others have argued that deminers who are protected will take greater risks and there will be more accidents as a result.

2.2 Difference in culture and economic setting

The above differences justify some variation in standards between the protection used in combat demining and that found in humanitarian demining, but not the degree of difference actually in place. To understand that the different conditions in the country have to be taken into account. I offer the following as an explanation rather than a justification. The most obviously relevant fact is that deminers are usually ex- combatants in the war that has ended. During that war they were usually poorly equipped, badly and irregularly paid, and subject to arbitrary and sometimes barbaric discipline. Often "recruited" to the military as little more than boys, they frequently have little or no formal education and no training that equips them for civilian life. One reason for their use as deminers is to remove them from the pool of redundant soldiers in the area and so reduce the problem of banditry. These deminers may well have committed atrocities during the conflict and will almost certainly have both laid mines and encountered mines laid by others. Without exception, those deminers to whom I have spoken are glad to have the job because of the secure income (usually in hard currency) and the kudos attached to both the demining activity and their association with foreign experts. I have never heard a deminer complain (even privately) about having inadequate protective equipment.

The cost of equipping a large number of deminers with protective wear to limit the injury to the few who have accidents has often been cited as a reason not to provide the equipment. For this to make sense one must be aware that demining is often put out to contract and the lowest bid accepted. In purely economic terms, the cost of expensive equipment can

only be justified if donors and insurance companies insist on it. The UN does not insist on high standards of equipment or insurance (US$2000 maximum cover being high). Consequently, many organisations can make insurance payouts directly without using third party insurers, so the requirements of insurance companies are not relevant. Injured deminers in developing countries, it is argued, are far better off than any civilian victim in the same area. The civilian will not get any compensation and will probably have to pay for whatever hospital treatment they can get. There is a vast difference in the level of insurance coverage provided for ex-patriot staff and the provision made for locals. I have heard this justified with the argument that deminers who were insured for large sums might deliberately suffer serious accidents in order to place their families on a secure financial footing. Such an argument may have some validity when the local culture includes a belief in Karma, but otherwise does look a little lame. The argument that the deminers consider the current payouts generous carries more weight.

Many people with whom I have spoken have also made comparisons between the risks involved in demining and those associated with other activities in the affected country. In some areas, they argue, life expectancy for ordinary civilians is very low anyway. Others have observed that the number of road traffic injuries experienced by demining groups is often higher than the number of mine related injuries. An even better comparison is between mine related injuries to civilians and to active deminers, with far greater numbers of civilians falling victim during any significant time period. Obviously this relationship will change in any given country as more and more mined areas are made safe, but in the countries I have visited there are still large numbers of civilian casualties (about 275 per month are recorded in Cambodia, for example, and probably many more go unrecorded).

Perhaps the most telling argument for not providing better safety equipment is the fact that the deminers do not want it. In most cases, I have found this to be true. Deminers who have to wear body armour and helmets in high temperatures for long periods complain bitterly. Their counterparts wearing industrial safety glasses count themselves lucky. In Cambodia, CMAC is finding it difficult to persuade deminers to wear full-face visors, never mind body protection. In Mozambique, I met one deminer who said that only women would need to wear a visor and I have frequently encountered a similarly macho dismissal of protective wear, even from the ex-patriot specialist in charge.

3. The growth of a standard

Other demining groups are beginning to take note of HALO Trust's standards. The HALO Trust was formed in 1988 and so is the oldest humanitarian demining group in existence—which may explain why

others respect the standards that HALO has slowly adopted (HALO did not use visors in Cambodia until 1995). However, HALO's belligerent management style and public (BBC 1995) support for continued military mine usage has made the organisation few friends in the demining industry. That said, the industry is scattered with ex-patriots who started with HALO, and most specialists respect their men in the field. Several other groups have noticed HALO's experience with full-face 5mm polycarbonate visors and have recently added them to their standard equipment. HALO has shown that they can be worn for long periods without a loss of productivity, so leading the way. It is easier for less experienced demining organisers to follow an established group and so avoid investing in poorly chosen equipment that ends up on the shelf.

The NGO MAG appears to apply higher standards than HALO with full body armour, helmet and visor, yet no other group is rushing to copy them. This may be explained by two apparent inconsistencies in MAG's approach. Firstly, in Cambodia last year only the person prodding or probing was wearing protective equipment. A detector operator in the next lane was wearing industrial safety spectacles and no body protection (if the prodder had detonated a fragmentation mine the man in the next lane might well have been injured). Secondly, MAG's SOP is for probing deminers to lie prone, which makes their uncomfortable body armour seem unnecessarily bulky. I (and others) have suggested to MAG that the back panel in the body armour seems superfluous, and pointed out that it also makes it hard to raise the head when lying prone. Field staff have agreed with some enthusiasm but UK staff have not.

I wore both MAG's equipment and the HALO Trust's in Cambodia to compare the relative comfort. I found that HALO Trust visors and frontal body armour can be worn in Cambodian heat with minimal extra discomfort, while MAG's helmet and close-fitting, high-collar, high-back body armour was a physical torture, especially when lying down to probe. Consequently, I am not surprised that MAG's equipment standards have not been copied.

The higher end of the standard currently in use is a 5mm polycarbonate full-face visor hanging on an adjustable head-frame. Untreated polycarbonate of this thickness has a V50 of around 280m/s and is very effective against blast. Field organisations report that they pay the European suppliers of these visors (LBA, UK) about $US100 each for bulk orders, plus delivery. The Zimbabwean manufacturer (SDL[****] of similar visors (supplied with carrying bags and hats) charges considerably less (about $US60 for bulk orders).

Most organisations using visors budget to replace them each year, so the necessary cost per deminer is about $US70 per year. Annual replacement is necessary because the visors scratch easily: scratch-resistant visors could be used, but they would be thicker and so heavier if they were to

offer the same protection. I have encountered one organisation trialing perspex visors, which I discouraged, and another using visors with bolts through the face. In both cases these were low-cost alternatives so demonstrating the preoccupation with price. It is hard to believe that donors would not support the supply of 5mm polycarbonate visors at around $US70 each and, if I am right to think this, the argument against their use because of prohibitive cost fails.

The argument that accident rates increase when the level of protection is raised cannot be wholly dismissed until a thorough study of accidents in humanitarian demining has been made, so allowing a comparative study relating the level of safety equipment to the frequency of accidents under like conditions to be carried out. The inconsistency and unreliability of existing data would mean that such a study would have to start by collecting original data and so take a long time to complete. In the meantime, it seems safest to presume that protective equipment is a good thing.

HALO has shown that deminers will accept the need to wear visors and other groups have begun to copy, so the suggestion that deminers will not wear them does not hold. There is, however, still some resistance to their use on grounds of discomfort.

It was the desire to enhance comfort that led me to work on several "optional extras" for the full-face visor. The first is a cheap and effective sun hat being worn by an Afghan deminer. The hat is popular and cheap enough to be adopted. It is certainly more comfortable than wearing a hat under the visor head-frame. Notice the way that a hat below the head-frame also raises the visor face and leaves the throat more exposed.

The third photograph shows a visor I designed with a built in solar-powered fan. The fan is a 12v 90 milliamp CPU fan, silent and cheap, but it requires a large PV area to power it. The helmet is formed from thin fibreglass in the prototype but would be thermoplastic in a production model. It is intended simply to shield the head from the sun and provide an all-round air gap between the helmet and the head. The visor provides the protection, being 5mm polycarbonate.

The prototype attracted some interest and I went on to make a much cheaper and simpler 4V 45 milliamp clip-on solar fan for full-face visors.

In field trials in Angola the deminers were very enthusiastic about the clip-on fan but in fact it was pretty ineffective in high humidity. Not wishing to promote something purely for its novelty value, I have not tried to get backing to establish production of this item. There may be scope for someone to develop a simple, higher powered alternative, but battery-powered versions should be avoided. A deminer is often paid $US5 or less a day, making the cost of an imported battery significant.

Cheap, robust and reliable solar battery chargers might make such an option viable.

Figure 2: An Afghan deminer (ATC) with an SDL visor

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Figure 3: A UN deminer in Angola wearing an LBA visor

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Figure 4: SDL visor with helmet and fan

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Figure 5: SDL visor with clip on solar fan

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4. Conclusions and prospects

It is possible that the UN and demining donors will force a rapid improvement in equipment standards, but this seems unlikely to happen quickly. It seems self evident that the current standards published by the UN are too high to be achieved in a single stage of equipment upgrade.

In any case, the current UN standards are unlikely to ever be considered "appropriate" by workers in the industry. When standards do improve, lightweight and comfortable wear, designed for non-combat use, should be available.

In the meantime equipment designers and suppliers should recognise the current constraints as need as *perceived* by the deminer community and low unit cost.

The deminer community's perception could be manipulated if the will were there. It is easy to imagine how deminers could be persuaded of the need to use better equipment by the persuasive force of professional (and graphic) video images and slick presentations. However, this would be expensive and no one seems inclined to do the work without proof of its benefits or a guarantee of payback through sales.

The cost constraints are dictated by the demining supervisors and controllers — often ex-patriots struggling to balance budgets. They, in turn are. constrained and have little room for manoeuvre. No matter what their personal opinion may be, new equipment usually has to show a payback in enhanced performance or in credibility with their funders. Improvements that cost a few dollars per deminer may be adopted quite quickly (as with simple handtools, sunhats or safety spectacles). Improvements that require a major investment in order to equip a large number of men are less likely to pass through the system at all.

There is some evidence to suggest that deminer-opinions could be a deciding force. Deminers went on strike in Mozambique to force the UNADP to honour previous agreements over pay and conditions and won, so it is possible that their opinions on equipment would carry weight.

From my experience, to convince deminers of the need for any new equipment it must be shown to make their work easier and/or quicker. If the latter, it might also find favour with their controllers. On the face of it, protective equipment seems unlikely to meet this requirement, but the protective-wear industry could take up the challenge and surprise us all.

I expect 5mm polycarbonate full-face visors to become the industry standard for head/face protection in the next two or three years. When that has happened, the issue of body protection will come to the fore. A deminer who kneels to probe for mines is exposing his thighs, genitals, body and arms to possible blast damage. The challenge to equipment designers is to offer cheap protection that deminers will wear. And of course, any answer is likely to be a compromise between cost, comfort and safety (just as 5mm polycarbonate visors are a compromise). Only after the need for basic body protection has been met will the industry give serious consideration to the need to stop high velocity projectiles,

and so consider upgrading head and face protection.

*** Leading to an apparently high incidence of scraping across the top of PMN pressure plates with predictable results.**

**** Those who defuse and dismantle mines can find the explosive useful when they subsequently destroy mines and UXO in a safe place. This is particularly so shortly after demining groups first arrive in a country with a ruined infrastructure when the supply of imported explosives and other equipment can be difficult.**

***** In my tests against mines in the field, 5mm visors have been severely damaged (2.5cm holes) by POMZ fragments at 1 meter but have also resisted all strikes from the same kind of mine at 0.65m. (My field tests have been conducted with the visor supported at 65cm from the edge of the mine, 30º away from vertically over it: this is fairly representative of its position when being worn by a kneeling deminer who probes directly only a pressure plate. In the case of the POMZs, the stake's point of entry to the ground represented the mine's position for measurement purposes.)**

****** As part of a charitably funded technology transfer programme, I helped SDL to start manufacturing these visors and have carried out frag and blast tests on them, comparing them with LBA versions. The results leave me confident that they offer at least as much protection as the European models, and are ergonomically better suited to use in humanitarian demining. I also carried out a similar technology transfer programme in Cambodia last year, when disabled mine victims from Veterans International were trained in visor manufacture.**

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I have been working on protective equipment for humanitarian demining for several years, sometimes as manager of the University of Warwick's "Mine-clearance support programme," and also with the University of Western Australia (I no longer work with Warwick). My work has involved research and product development, the commercial introduction of protective products in the field (commercially exploited by local manufacturers rather than myself). I have undergone training courses with the British Royal Engineers (RE) and received field instruction from several demining groups. I have organised (and frequently implemented) blast tests on equipment against real mines with MgM, CMAC, the Zimbabwean army, NPA, MAG, and HALO, and against PE4 based simulations with the British RE. My work has involved spending time with demining groups in the field and conducting formal and informal interviews with specialists and deminers, supervisors and managers. I have spent time in mined areas in Mozambique, Angola and Cambodia, and interviewed deminers on the Pakistan/Afghanistan border.

Prior to working on mine-clearance, I worked for several years as a development engineer and trainer on projects in rural Africa. I am formally trained as a teacher (PGCE) and am an experienced designer, researcher and technical trainer, as well as a competent all-round technician. The opinions expressed in this article are solely those of the

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