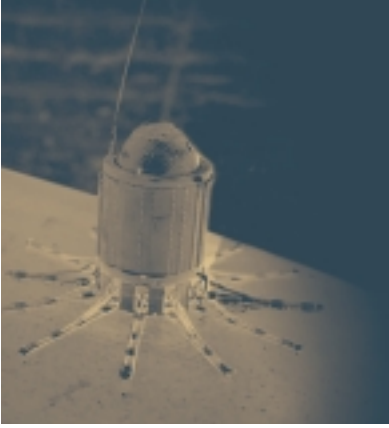

Alternative anti-personnel mines
The next generations

SUMMARY

The 1997 Ottawa Treaty banned the use, production, stockpiling and transfer of anti-personnel mines. Unfortunately, landmine technology has moved on and distinctions between mines designed to kill or injure people, and mines labelled anti-tank or anti-vehicle, are not always clear. Many new mines are designed to be dual purpose and may be detonated by both people and vehicles, and in some cases merely the proximity of people or vehicles. Meanwhile it has been unclear to what extent munitions and new technologies that may function as anti-personnel mines continue to be deployed and developed.

This report identifies victim-activated weapons, both in existing stocks and in development, which may function as anti-personnel mines or have the same impact on civilians and are being retained or developed by armed forces and manufacturers, including those of states that have ratified the Ottawa Treaty.

Landmines and definitions

All landmines have an anti-personnel capability, since all can cause human casualties. The Ottawa Treaty, however, attempted to draw a distinction between mines designed to be activated by a person rather than a vehicle such as a tank. At the core of the definition in the Treaty are the features of anti-personnel mines that had for many years caused widespread concern: that they are 'victim-activated' and therefore indiscriminate.

But landmines designed primarily to attack vehicles increasingly contain these indiscriminate anti-personnel functions, either by containing 'anti-handling devices' that are supposed to protect the mine from being moved, or by having fuzes sensitive enough to be triggered by a person. Since the Treaty entered into force, some governments have destroyed stocks of anti-vehicle mines with the capacity to function as anti-personnel mines, or passed legislation that includes such mines within prohibitions; but other governments have retained the same weapons.

Existing alternative anti-personnel mines: anti-vehicle mines

Anti-vehicle mines with anti-handling devices

By definition, anti-handling devices are anti-personnel – they are designed to prevent a person's disturbance of an anti-vehicle mine. Like anti-personnel mines, they cannot distinguish between combatants and civilians, and so represent an equal danger to civilians, humanitarian deminers and soldiers.

There are a number of different types of anti-handling device, all of which are very sensitive. Technical literature suggests that between 50 per cent and 75 per cent of existing anti-vehicle mine types are equipped with anti-handling devices. Austria, Belgium, the Czech Republic, France, Germany, Spain, Norway, Sweden and the UK all possess anti-vehicle mines with anti-handling devices.

One example is the German AT-2, a scatterable anti-vehicle mine equipped with an anti-handling device, which is in service in several NATO countries including the UK, Norway, France and Germany. The mine's sensors pass on signals to the electronic fuze (to detonate the mine) if there are attempts to handle or move the mine or if the mine's target sensor, rising up like an antenna from the top of the mine, is touched. Along with its anti-handling device, the magnetic fuzing of the AT-2 makes it possible for the mine to be detonated by an unintentional act, for example by the slight movement caused by a person walking into or stumbling over it. On detonation the AT-2 mine will normally cause catastrophic damage to a vehicle as well as propel secondary fragmentation out to a radius of 150 to 225 metres. In 1997 the Italian government concluded that the AT-2 was sensitive enough to be detonated by a person and ordered the destruction of all 45,000 AT-2 mines in Italian stocks.

Anti-vehicle mines with personnel-sensitive fuzes

In addition to anti-handling devices, there is a range of means by which landmines may be activated by a person.

German Initiative to Ban Landmines

landmine action
THE CAMPAIGN AGAINST LANDMINES

Device Type	
The anti-personnel mine used as a fuze	An anti-tank or anti-vehicle mine manufactured so that it is fuzed with an anti-personnel mine. A person stepping on the anti-personnel mine initiates both mines.
Low pressure thresholds	Some mines are capable of detonation upon pressure of 50 kg or less. A running person can apply pressure of up to 150 kg to a mine fuze when striking it with a heel.
Tilt rod fuzes	A thin flexible pole protruding from a mine, attached to the fuze. When pressure is applied against the rod the mine is activated. The operating pressure of a tilt rod fuze is typically only a few kilograms. Many anti-vehicle mines have been designed so that tilt rods can be fitted. Tilt rods can be so sensitive that a person walking through undergrowth concealing a mine could initiate it by accidentally striking the rod.
Trip wires and break wires	Trip wires function when tension in the wire is released or if the wire is pulled. Usually the wire is stretched across a target area and the mine triggers when enough traction or release is applied. A break wire activates a mine when an electric circuit within the wire is broken. This can happen when the break wire is hidden or buried. Both are likely to put the safety of civilians at risk.
Magnetic sensors	Often used in anti-vehicle mines because they are cheap and can operate for extended periods. Designed to sense a change in the magnetic field, and cause the mine's detonation, passive magnetic sensors may be very sensitive to any metal objects placed nearby or approaching the sensor, eg hand-held radios brought into the vicinity of the mine, keys and other metallic objects carried by a person. Lightweight, scatterable anti-vehicle mines with magnetic fuzes, that remain on the ground surface and are readily knocked into a different position, are likely to be easily detonated by an unintentional act.
Anti-vehicle mines fuzed (or 'woken up') by other sensors	There is a range of sensors designed to trigger modern anti-vehicle mines. Most common among these are seismic sensors, which react to vibrations in the ground. Acoustic sensors react to the noise made by a vehicle engine. Light-sensitive sensors activate when uncovered and exposed to light. Infrared sensors react to radiated heat. Fibre-optic cables react to being driven over. Some anti-vehicle mines are equipped with a mixture of sensors. It is unclear how discriminating any of these sensors are – can they distinguish between a heavy civilian vehicle like a bus and a tank?

Country case studies

United Kingdom

The UK manufactures and retains stocks of mines which could have anti-personnel capabilities because of their anti-handling devices or the sensitivity of their fuzes. These are the Barmine (according to the Government 'no anti-handling device is fitted to this weapon, but disturbance of the mine may, in some circumstances cause it to detonate'); the AT-2 ('the anti-handling device fitted to this weapon would cause detonation after deliberate and sustained movement of the mine') and the Shielder's L35A1 procured from the US ('no anti-handling device is fitted to this weapon, but disturbance of the mine may, in some circumstances cause it to detonate').

Of further concern are mines that the Ministry of Defence is in the process of acquiring. These include the ARGES anti-tank weapon (Automatic Rocket Guardian with Election Sensor) from the family of weapons known as ACEATM (Aimed Controlled Effect Anti-Tank Mine). The system is initiated by an acoustic sensor and a target selection system, while firing is initiated by a passive infrared detection system and laser. Another future UK system in procurement is the Area Defence Weapon, known in the US as the Hornet Wide Area Munition. This is a hand emplaced mine that senses and tracks vehicles, even if the vehicle has not run directly over it, then fires a warhead which fires a heavy metal projectile at the target from above. It uses acoustic and seismic sensors, and can attack a vehicle from a distance of 100 metres. Again 'a non-lethal anti-handling device would switch the weapon off if disturbed'.

UK firms continue to co-operate with European firms on the production or development of anti-vehicle mines: the ARGES, produced in a consortium including Hunting Engineering; and the AT-2 MLRS project, including BAE Systems and Hunting Engineering (see below).

Germany

From 1990-1999 Germany spent DM 2.5 billion (£800 million) on modernising mine equipment, including procurement of anti-vehicle mines with anti-handling devices. Major companies have been involved including Dynamit Nobel, Diehl Stiftung, Rheinmetall and Daimler Chrysler, with many other companies producing components. Other major companies which are involved in marketing, developing and producing anti-vehicle mines,

components and delivery systems, include Honeywell, Krauss Maffei, Junghans, and RTG-Euromunition.

The MLRS EPG (European Production Group) project involved European co-operation on a large scale, for production of the MARS/MLRS artillery launcher that can dispense AT-2 mines. The launcher is a European joint license production led by Diehl (Germany), Daimler Benz Aerospace (Germany), Thyssen Henschel (Germany), BPD Difesa (Italy), Aerospatiale (France) and Hunting Engineering (UK) (responsible for the warhead assembly). Other UK companies involved in the MLRS project are Marconi, GEC Avionics, Hughes Microelectronics as well as BAE Systems/RO Defence. A new guided AT-2 rocket for the MARS/MLRS launcher is currently under development.

German military authorities, and a German mine producing company, have unofficially confirmed that the DM-31 AVM (in Sweden called the FFV-028) manufactured by Bofors AB in Sweden and Dynamit Nobel in Germany, can be detonated by the presence of metallic objects. Sweden, Canada and the Netherlands also stock the FFV-028. Canadian military authorities stated that the mine is activated by changes in the electromagnetic field around it and that the DM-31/FFV-028 mine may be set off by sweeping a metal detector over the mine. The Dutch Ministry of Defence apparently believes the mine may not be compliant with the Ottawa Convention because of the highly sensitive nature of its sensor.

Germany produces landmine sub-munitions such as the MUSPA (Multi-Splitter Passiv Aktiv) for use with dispenser systems. The MUSPA is classified as anti-personnel by Italy and the United States. It is distributed from the MW-1 cluster munition dispenser. The MUSPA has a passive sensor system that can detonate by acoustic or physical contact.

Anti-vehicle mines: the humanitarian impact

Anti-vehicle mines can cause a significant threat to civilians and hamper development and mobility of a whole region. In Mozambique, a single anti-vehicle mine on the road linking Milange and Morrumbala cut these two district capitals off from the rest of the world for over 10 years.

Reports from non-governmental organisations, including those engaged in mine clearance, detail civilian casualties, the denial of access to impoverished areas and wider socio-economic problems caused by anti-vehicle mines that have already been deployed – in short, a similar impact to the presence of anti-personnel mines. The following are a few brief examples of the impact of anti-vehicle mines in mine-affected countries.

Afghanistan: since 1991, more than 400,000 people have been killed or maimed by landmines in Afghanistan. According to the Comprehensive Disabled Afghans Programme (CDAP), as many as 210,000 people in Afghanistan have disabilities caused by landmines. The UN reports that landmines have a considerable impact on roads and other transportation routes. During the war, many important routes were mined, preventing or restricting the movement of public transport. Delivery of goods to most destinations in Afghanistan has been made more difficult, resulting in price rises. Increased transport fares and extended travel time has resulted, per year, in a loss to the Afghan economy of more than US$26 million.

Angola: it has been estimated that in Angola one in every five landmines is an anti-vehicle mine. Mines laid on roads are a major impediment to the freedom of internal movement. By November 2000, the National Institute for the Removal of Obstacles and Explosive Devices (INAROEE) had recorded 2,617 mine fields in Angola. INAROEE reported 204 mine-related accidents throughout the country in the first six months of 2000, with 100 people killed and a further 327 injured. Of these, 327 were civilians. Most of those affected (251 people) were killed or wounded by mines when they travelled in vehicles on roads.

Ethiopia/Eritrea: in the recent 19-month border war between Ethiopia and Eritrea landmines were planted by both sides. These mined areas are currently unmarked and unmapped. In Ethiopia it is estimated that 20 per cent of all laid mines are anti-vehicle mines. Reports indicate that large areas of farmland are expected to remain idle until mines have been cleared.

Kosovo: in 1999 the Yugoslav Army and security forces used both anti-vehicle and anti-personnel mines in abandoned positions, around civilian centres and extensively along the Albanian and Macedonian borders. According to the UN, a total of 7,232 mines (3,448 anti-personnel and 3,784 anti-vehicle) were cleared between June 1999 and May 2000, following the withdrawal of Yugoslav forces. In the same period, eight people were killed and fifteen injured by anti-vehicle mines in Kosovo.

Future alternative anti-personnel mines

Since the signing of the Ottawa Treaty there is evidence of the rapid proliferation and procurement of systems that can mimic the function of anti-personnel mines. Some of these alternatives are essentially modifications of existing weapons, while others are based on more advanced weapons technology. Within the US in particular, many different technologies are being investigated to produce anti personnel mines alternatives, some labelled lethal and some labelled 'non-lethal'. Among the concepts being examined in the US under its $800 million anti-personnel mine replacement programme, a proposed system known as 'RADAM' would clearly be illegal under the Ottawa Treaty as it contains anti-personnel mines. There are serious doubts as to the legality of other proposed concepts.

'Non-lethal' anti-personnel mine alternatives	
'Non-lethal' adaptations of existing anti-personnel mines	A new US variant of the mine known as a 'Claymore' is termed the Modular Crowd Control Munition. Using 'stinging rubber balls' and the existing Claymore mine dispenser, this is listed as a means of breaking up crowds and hostile personnel, temporarily incapacitating at close range (5-15 metres). This proposal has already gone to contract, with Mohawk Electrical Systems, current manufacturers of the Claymore M18A1 mine, involved. The MCCM now has a NATO Stock Number, and costs $255 per munition.
Calmatives	A range of tranquillising chemicals being examined by US researchers can cause temporary blindness; others can cause submissiveness or extreme anxiety. Systems for delivering calmative agents include a micro-encapsulation programme that can disperse victim-activated calmatives (by releasing their effects only when trodden on).
Obscurants	These aqueous foams form an impenetrable soap-suds-like barrier. Fired in bulk from water cannon or specially designed back-packs, foams can be piled up into semi-rigid barriers and laced either with chemical irritants or calmatives. If the foam is entered, disorientation occurs. The dose received will increase all the time that the person is in contact with the foam.
Entanglements	Varieties include slippery substances, expanding sticky foam guns and barrier devices, and nets, which come with options for including sticky adhesive, chemical irritant, electroshock and hooks. Many of these entanglement devices, also known in the US as 'stickums' and 'slickems', are now available commercially.
Directed energy weapons	The potential use of so-called radio frequency or directed energy weapons has been proposed for anti-personnel area denial including dazzling lasers, microwaves and vortex ring technologies.
	Microwave devices are seen as offering a tunable response from less-lethal to lethal, as so-called 'progressive penalty munitions'. The 'onion' or 'layered defence' model which accompanies proposals for their deployment describes entering the outer layers as inviting a punitive response, whilst the central core is lethal. Already demonstrated is the ability to induce a heating effect up to 107 degrees F to induce an artificial fever. High-powered microwave weapons are likely to become an increasing feature of 21st century warfare as manufacturers aim to design systems which fire electrons rather than bullets.
Acoustic weapons	Allegedly able to vibrate the inside of humans in order to stun, nauseate or, according to one Pentagon official, to 'liquefy their bowels and reduce them to quivering diarrhoeic messes'. Twenty US companies are involved in developing these weapons in a wide-ranging research effort to support 'active area denial programmes'. One major contractor is quoted as saying high power acoustics can produce 'instantaneous blastwave-type trauma' and lethal effects with even modest exposure. Also labelled as Projected Energy, Sonic, and Forward Area Energy Weapons, three types are being examined by the US Army and Air Force: an acoustic rifle, a vehicle or helicopter-mounted acoustic gun for longer ranges, and an air-dropped acoustic mine.
Electrical weapons	US companies Tasertron and Primex Aerospace are testing the Taser Area Denial Device, which lands primed to be victim-activated by a trip device and a variety of other sensors. Once activated, barbed darts are fired in a 120 degree multi-directional pattern, with 'volcano darts' fired in a single direction. The darts reach out some 15-30 feet and 50,000 volts is pulsed through to the target, temporarily incapacitating the person, even through clothing. Tasertron claim this will cause uncontrollable spasms of the subject's motor control functions. The subject remains conscious and alert but cannot control his muscles.
Bio-weapons for racially selective mass control	Breakthroughs in the Human Genome and Human Diversity Projects potentially enable the use of blood proteins to attack a particular racial group using selected engineered viruses or toxins. As the data on human receptor sites accumulates, the risk increases of breakthroughs in malign targeting of micro-organisms at either cell membrane level or via viral vector. In the US the newest micro-encapsulation dispersion mechanisms for chemical and biological weapon agents are being advanced for 'anti-materiel and anti-personnel non-lethal weapons related to area denial and vessel stopping'.
Robotic area denial systems	Robots activated by surveillance systems to make selective attacks with less-than-lethal devices. In 1983 Robot Defense Systems of Colorado created the Prowler – an armed two-ton vehicle designed for sentry duties. A number of 'concept demonstration' robots – armed autonomous robots independently identifying and engaging targets – exist. The most advanced is the Robart 3, which includes a Gatling gun-type weapon that fires darts or rubber bullets. Other armed robot concept models include the Roboguard, developed in Thailand. Automatic victim activation is possible via heat sensors which track people as they move.

Existing 'off-the-shelf' alternatives to anti-personnel mines

Many of the landmine alternative technologies already in existence have formats that give them 'mine-like' characteristics. Some of these technologies can be automated and if operating in this mode are essentially victim activated.

Victim-seeking automated guns and explosive-driven ordnance

Victim-seeking automated guns are now being marketed for border control, embassy protection and controlled environments such as nuclear power plants. For example, the Automated Weapons System made by the US company Autauga Arms Inc. is a camera-mounted concealed machine gun that can be set to automatically open fire if the boundaries of its control-zone are infringed.

There are several systems which may lend themselves to field adaptation for use as mine-like weapons. Where such anti-personnel systems are automatic and victim-activated, this appears to bring them within the scope of the Ottawa Treaty. For example, the Lacroix Sphinx-MODER Perimeter Defence can fire operational rounds including fragmentation, smoke, CS and warning rounds. Other companies such as Mark Three advertise anti-personnel mine conversions to their Bear Trap system. This is ordinarily a jackhammer shotgun with a multi-cartridge cassette but is so designed that the cassette cartridge can be removed, placed in the ground and pressure-activated so that all cartridges are fired together, in other words as an anti-personnel mine.

'Non-lethal' alternatives to anti-personnel mines

'Non-lethal' weapons doctrine in the US

Recognition of the need to fight 'wars of intervention' grew in the US in the early 1990s with the end of the Cold War and the failure of the US mission to Somalia. One result was the creation of a doctrine where civilians could legitimately be targeted with non-lethal weapons alongside insurgents. This change in approach was claimed to be legitimate because the targets would not be harmed. This doctrine says it is unrealistic to 'assume away' civilians and non-combatants, taking the view that the US must be able to execute its missions in spite of operating in the midst of civilians. 'Non-lethal common tasks' include incapacitating or stopping an individual in a room, or in a crowd, or fleeing.

The US Army identified a range of tools for these missions, many of which have anti-personnel mine-like qualities or could mimic some of their attributes. The potential target categories for these non-lethal weapons included combatants, criminals, hostages, non-combatants, refugees, rioters and disaster victims. By the late 1990s US doctrine on anti-personnel mine alternatives was successfully assimilated into NATO policy. Research into these alternatives continues in the UK, Germany and the US.

Conclusions and Recommendations

Anti-vehicle mines functioning as anti-personnel mines

Continual technological development of mines has made old distinctions between anti-personnel, anti-vehicle and anti-tank mines far less clear than may once have been the case. Although a manufacturer or country may designate a mine as anti-vehicle or anti-tank, this does not guarantee that it does not also have anti-personnel effects. There is a range of fuzes and anti-handling devices that appear to enable anti-vehicle mines to function as anti-personnel mines, or at least have variants that are anti-personnel.

Developers have yet to demonstrate that new mines' sensor technologies discriminate reliably; for example, in the case of magnetic fuzes, there are serious questions as to which fuzes are capable in different circumstances of being initiated merely by the approach of a person.

Furthermore, reports from at least 25 countries mine affected countries show that anti-vehicle mines cause the deaths of many civilians. They tend to kill rather than maim civilians, and when they are detonated by civilian vehicles there is usually a large number of casualties. Despite the evidence, manufacturers of anti-vehicle mines continue to export weapons that damage economies and deny civilians the use of land, as effectively as anti-personnel mines.

Future alternative anti-personnel mines

The development of non-lethal alternatives does not herald harmless warfare. In many of these new weapons systems, and the scenarios in which their use is envisaged, it is difficult to find the discrimination between civilians and enemy combatants and the avoidance of victim-activation which are at the heart of the Geneva Conventions and the Ottawa Treaty's prohibition of anti-personnel mines.

Information available suggests that alternatives to anti-personnel mines may breach existing international law but public knowledge and understanding of the potential human rights implications posed by some alternative landmine technologies remains relatively undeveloped. Most official sources are either lacking in technical detail or overlook the ways in which these emergent technologies are victim-activated and civilian-targeted.

Recommendations

Anti-vehicle mines

Member States of the Ottawa Convention should transparently assess the sensitivity of all existing anti-vehicle mines, report this promptly to the United Nations under the existing Ottawa Convention reporting framework, and destroy stocks of all anti-vehicle mines found to be capable of activation by the unintentional act of a person.

Alternatively, states should provide convincing technical and field information, making it available to independent observers such as specialist non-governmental organisations, that demonstrates these mines are not in breach of the Ottawa Treaty. Pending this transparent technical assessment, there should be moratoria on the manufacture and export of anti-vehicle mines likely to function as anti-personnel mines. These should be declared unilaterally.

For those mines that can be shown not to fall within the Ottawa Treaty, there is an urgent need to impose greater responsibility on users. A new fifth protocol to the Convention on Conventional Weapons is necessary to impose an unambiguous obligation on the users of anti-vehicle mines to implement full clearance and supporting activities. These should include marking mined areas as soon as the affected territory is no longer subject to combat operations. Where this is not practical, the responsible party should be financially responsible for clearance operations carried out by non-governmental organisations under the auspices of the United Nations.

Future alternative anti-personnel mines

Governments should ensure that all weapons research and development is within the limits established by existing international humanitarian law. Existing programmes should be transparently examined for compliance with existing humanitarian law, and terminated if found to be in contravention.

To provide effective scrutiny of these new technologies by civil society, and to ensure their full compliance with existing humanitarian law:

- research on chemicals used in any alternative mine technologies (eg calmatives and sticky nets and malodourous substances) should be published in open scientific journals before authorisation for any usage is permitted. The safety criteria for such chemicals should be treated as if they were civilian drugs rather than military weapons.
- research on the alleged safety of existing crowd control weapons and of all future innovations in crowd control weapons should be placed in the public domain prior to any decision towards deployment. Past experience has shown that to rely on manufacturers' unsubstantiated claims about the absence of hazards is unwise. All research justifying the alleged harmless status of any 'less lethal' weapon to be published in the open scientific press before authorisation and that any product licence granted be subject to the same scrutiny.

Governments should consider institutionalising the decision making process so that common parameters are used when deciding on alternatives to landmines, along the lines of environmental impact assessments. In practical terms that would mean having formal, independent 'Social Impact Assessments' of such technologies before they are deployed. These assessments could establish objective criteria for assessing the biomedical effects of so called 'less lethal' weapons, undertaken independently from commercial or governmental research.

Finally, states devoting resources to the development of alternative anti-personnel mines that are in breach of international humanitarian law should redirect this expenditure towards more rapidly clearing mines already laid, rehabilitating their victims and destroying stockpiles.

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