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Economics of landmines and demining

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Economics of Landmines and Demining

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June 2009

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13. ABSTRACT

Landmines threaten human lives and the welfare of mine-affected countries. They cause an economic burden both by destroying lives and by limiting the valuable use of land. Landmines remain dangerous for decades after they are deployed, killing or injuring civilians and rendering land impassable and unusable.

Historically, studies of the impact of landmines mostly focused on safety issues and the risk of injuries and deaths. More recently, it has become obvious that landmines can interfere with the overall economic development of mine-affected nations. In reaction to the problems posed by landmines, the world community has responded with attempts to tackle the problem of landmines. A newly formed "mine action" industry has grown rapidly in the last decade. Mine-affected countries, international organizations, non-governmental organizations (NGOs), and donor countries are among those supporting mine action programs to alleviate suffering and assist in the reconstruction of mine-affected nations.

There are many ways to reduce the impact of landmines, but the most common practice is demining. Demining is quite dangerous and expensive to implement and involves many complex challenges. It utilizes scarce resources including time, manpower, and money. Furthermore, in many countries landmines are so widespread that completely demining affected areas would create an enormous economic burden. This study attempts to identify and evaluate alternative approaches to demining in order to provide recommendations on the most cost-effective options for a country to make the best use of its scarce resources to guarantee civilian safety and promote economic development.

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ECONOMICS OF LANDMINES AND DEMINING

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ECONOMICS OF LANDMINES AND DEMINING

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I. INTRODUCTION

A. BACKGROUND

Mines are designed to be activated by persons and vehicles or tanks. Mines are used in an armed conflict to fix movement, divert direction, and disrupt the progress of the enemy, or otherwise kill or maim the enemy.

Mines laid by opposing forces can also have the intent of providing protection, causing terror, preventing the civil population from returning home, or forcing the civil population to leave. Mines laid may or may not have been recorded. Usually, there are no records kept for mines that are laid during guerilla fighting or civil conflicts. They are easily laid by various means within a short period of time.

Generally, mines are considered safer to place than to remove. Mines can "live" for an extremely long period of time until detonated or removed. Today, most minefields are neither mapped nor recorded, and those who laid them may no longer exist. Such phenomena make landmines difficult and hazardous to address. Mines, in most cases, are left behind after ceasefires or cessations of hostilities. Civilians are routinely victimized by landmines since they are not aware of their existence or location. Many civilians are killed or maimed as they return from displacement camps and attempt to resume their lives.

Until recently, according to the Landmine Survivors Network, 84 countries are thought to have mines located in their territories including a total estimated eighty million landmines.[1] According to the International Campaign to Ban Landmines (ICBL), landmines and unexploded ordinances (UXO) cause over 15,000 civilian causalities per

[1] Landmine Survivors Network Web page, "Scale of Problem," http://www.landminesurvivors.org/what_landmines.php (accessed December 6, 2008).

year, mostly in rural areas of developing countries.[2] The International Committee of the Red Cross (ICRC) estimates 26,000 causalities annually.[3]

Landmines, left after ceasefires or the cessation of hostilities by conflicting parties throughout the world, are dangerous and pose significant threats to human and animal life. Equally important (and deadly), the threat of mines can have a devastating impact on social and economic development. Landmines put a tremendous burden on post-conflict host nations. They undermine food security by denying access to farmland and grazing land, water and fuel (wood) sources, and food gathering areas.

Not only are treatment and rehabilitation costs for landmine victims extremely high, but the inability to repatriate refugees and settle "internally displaced people" (IDP) undermines economic development. Economic dis-location caused by landmines in conflict-torn nations is a key impediment to economic growth.

As landmines provide a significant obstacle to economic growth and survival, their use needs to be challenged. In pursing economic development and laying out economic goals in developing nations. The issue of landmines needs to be considered concurrently and explicitly integrated into development plans. "The United Nations estimates that, in 1993, approximately 2 million new landmines were laid. During that same period only 100,000 landmines were lifted."[4] Ideally, a mechanism should be devised to prohibit the use of landmines.

In the late 1980s and early 1990s, the severity of landmine causalities dismayed aid workers, civil war observers, and non-governmental organizations (NGOs), which led to a joint effort to ban landmines. The International Campaign to Ban Landmines (ICBL) worked for several years advocating the ban of landmines. During campaigning for the ban, landmine use was noticed in a greater degree as indiscriminate and injurious. Understanding the severity and excessive impact in human suffering, nations signed the

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[2] International Campaign to Ban Landmines (ICBL), "Landmine Monitor Report 2002: Toward a Mine-Free World," (2002).

[3] International Committee of the Red Cross (ICRC), "Daily Bulletin of the 27th International Conference of the Red Cross and Red Crescent," (1999).

[4] Shawn Roberts and Jody Williams, *After the Guns Fall Silent: The Enduring Legacy of Landmines* (Washington, DC: Vietnam Veterans of America Foundation, 1995), 33.

Ottawa Treaty in 1997. As of June 20, 2008, 156 countries have signed and 131 have ratified the Ottawa Treaty.[5] The Ottawa Treaty also obliges state parties to mark all minefields on their territories within four years; and to clear all minefields within ten years of accession to the Treaty. [6]

Since landmine removal is an expensive option, and resources of mine-affected countries are scarce, it is not possible to clear all landmines in a reasonable period with limited budgets. Therefore, it is important to investigate and recommend alternative solutions to the challenges posed by landmines. A country may not need to spend all of its scarce resources removing landmines if other alternatives are more cost-effective. Benefits derived from clearing land and other alternative solutions can be evaluated based on the dual goals of reducing risks and increasing economic growth. Recommendations can then be made whether and how to clear specific areas, or to look for other options.

B. PURPOSE OF THE STUDY

This study attempts to identify and evaluate alternative approaches to demining in order to provide recommendations on the most cost-effective options for a country to make the best use of its scarce resources to contribute to civilian safety and promote economic development. The purpose of this project is to clearly formulate the problem, conduct a literature review about the economic impact of landmines and alternative interventions, compare economic costs of landmines against the costs of demining, describe possible funding mechanisms, and identify barriers that increase the costs of demining.

C. RESEARCH QUESTIONS

- What is the landmine problem?
- What is the scale of the problem?
- What are alternative solutions to the problem?

[5] ICBL, http://www.icbl.org/treaty/members (accessed December 6, 2008).

[6] Robert Keeley, "Understanding Landmines and Mine Action," (2003): Annex C.

- Who are the players in the mine action industry and what are their sources of funds?
- How is demining structured and financed?
- What is the economic impact of landmines?
- What are cost impact implications of landmines?
- How can demining be conducted in the most cost-effective way?
- How should incentives be structured so that the right land gets de-mined at the lowest possible cost?
- What are lessons learned from past studies?

D. ORGANIZATION

Chapter I of this project presents an overview and background of the landmine problem, purpose of the study, research questions, and organization of the study.

Chapter II provides a broad overview of the history of landmines and demining, past studies, and discusses the types of landmines.

Chapter III examines the structure and finance of demining activities and describes the organizations in the mine action industry.

Chapter IV provides an analysis of the economic impact of landmines and their cost implications. This chapter also suggests solutions to the landmine problem and evaluates alternatives.

Chapter V summarizes the findings and presents conclusions and recommendations for further research.

II. LITERATURE REVIEW

A. TYPES OF LANDMINES

According to the International Mine Action Standard (IMAS), land mines are "munitions designed to be placed under, on or near the ground or other surface area and to be exploded by the presence, proximity or contact of a person or a vehicle."[7] Landmines are classified into two categories: anti-personnel (AP) landmines and anti-tank (AT) landmines. AP landmines are designed to be activated by the contact of people. Their main function is to divert, fix, or disrupt infantry and light vehicles. They are also used as force multipliers, substituting for soldiers by guarding and inducing caution in enemy troops. Landmines are considered economical and efficient substitutes for scarce military personnel.

AT landmines are designed to defeat tanks and other armored vehicles in combat. Their functions are similar to AP mines but their targets are vehicles and tanks. Mines are mainly installed by combat engineers but can be laid by anyone with rudimentary training. Their simple and lethal nature means mines are widely used and leave a dangerous legacy.

Other explosive ordnances such as improvised explosive devices (IEDs) and unexploded ordnances (UXO) are equally dangerous. According to the IMAS definition these ordnances are part of a larger group of

> All munitions containing explosives, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and small arms ammunition; all mines, torpedoes and depth charges; pyrotechnics; clusters and dispensers; cartridge and propellant actuated devices; electro explosive devices; clandestine and improvised explosive devices; and all similar or related items or components explosive in nature.[8]

[7] United Nations Mine Action Service (UNMAS), "Glossary of Mine Action Terms, Definitions and Abbreviations," International Mine Action Standard 04.10 (2003):18.

[8] Ibid., 12.

1. Anti-personnel Mines

Anti-personnel mines are usually small. They contain explosives inside a round cylinder or box-like shape of plastic, wood, or tin materials. AP mines are found either under or above the ground well camouflaged in order not to be easily detected. They are activated by push, pull, pressure, or sensor. Thus, they are very sensitive. Their small size allows them to be easily transported and stored. A couple of AP mines can be carried by a person and laid anywhere anytime.

The design and capability, as well as the utility of landmines, have developed over time to fit current conflict situations. Militants prefer their mines to badly injure their enemies rather than kill them. When a friendly soldier is killed, his unit may ignore him, as there is nothing they can do for him, and keep on progressing with their fight. In addition, they can think about the disposition of the dead body. However, when a soldier is maimed an immediate withdrawal of the injured soldier is imminent.

This action costs a friendly unit a lot of manpower, creates a logistical and economical burden from his unit (such as medics, stretchers, carriers, doctors, and nurses), and requires more time and effort to cure the injury. Moreover, friendly units may lose their lives to save the injured soldier. Therefore, landmines are better designed to maim rather than kill because of the impact they cause on opposing forces. Therefore, designers change the content of the TNT inside the mine, as well as the mine's shape, size, make, and performance, depending on what kind of job it is intended to do.

There are hundreds of different types of AP mines produced in multiple countries. AP mines are further divided into two main groups based on their performance: AP blast mines and AP fragmentation mines.

a. AP Blast Mines

AP blast mines tend to be small, flat and cylindrical, and typically 60-140 mm in diameter.[9] They injure their victims through the blast effect of the explosives.

[9] UNMAS, "Glossary of Mine Action Terms."

They are designed to detonate when a person comes in contact with or steps on the mine. They affect the closest proximity of a person's body part such as the foot or leg. AP blast mines are usually buried a few inches deep in the ground and camouflaged. This makes the planting of mines faster, allowing for lots of AP mines to be laid in a short period of time. AP blast mines are not that lethal but do cause injury and therefore they greatly impact the enemy's logistical burden.

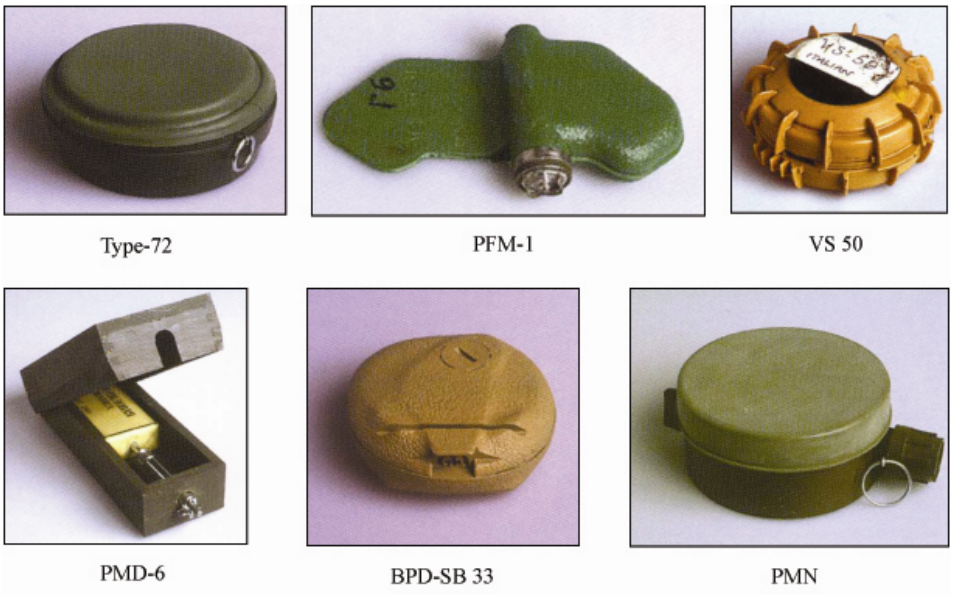

Figure 1. Various Types of AP Blast Mines[10]

b. AP Fragmentation Mines

AP fragmentation mines can be lethal. They function by detonating explosives, thereby driving metal or glass fragments of their case into anyone in proximity. Their fragments can be uni-directional or multi-directional. They are activated by a person with a tripwire or they can be electrically activated by a remote operator much like an IED. Unlike blast mines, fragmentation mines are capable of killing or injuring many people at once.

[10] Geneva International Center for Humanitarian Demining (GICHD), *A Guide to Mine Action*, (2004), 8.

AP fragmentation mines resemble hand grenades but are found buried underground or fixed in a stake above the ground with a trip wire attached to their safety pin. AP fragmentation mines can also be found in different forms such as AP bounding fragmentation mines and AP directional fragmentation mines. AP bounding fragmentation mines are designed to jump out of the ground and detonate after they reach a certain height in the air. Such mines are designed to injure or kill by attacking the upper body part of any person in proximity.

AP directional fragmentation mines are crafted in such a way that the main explosive force is directed outwards towards the enemy. They were originally designed to be placed in front of defensive positions and detonated in the face of human-wave type frontal assaults. Directional fragmentation mines have a lethal arc of about 45 degrees and can maim or kill at longer distances.[11]

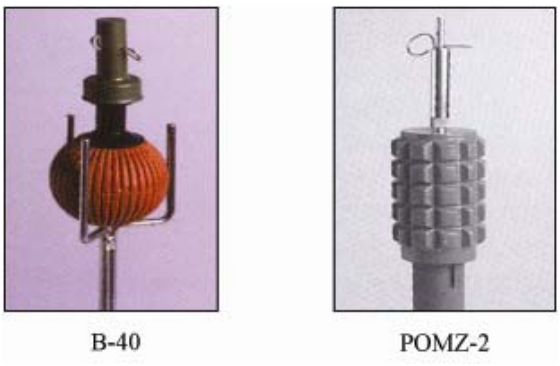

Figure 2. Fragmentation Mines[12]

[11] GICHD, *A Guide to Mine Action*, 8.

[12] Ibid.

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Figure 3. Bounding Fragmentation Mine[13]

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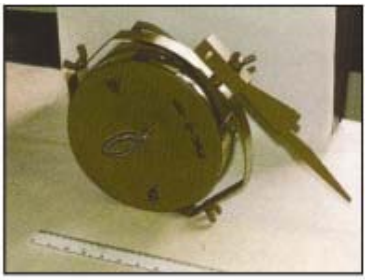

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Figure 4. Directional Fragmentation Mines[14]

2. Anti-tank Mines

When compared to AP mines, AT mines are larger and filled with more explosive in order to defeat a tank. AT mines are not activated by a person because they are designed to have a set operating pressure (heavier weight) to avoid people initiating the detonation. The aim of an AT mine is to stop the mobility of a tank or a vehicle by blowing its interior body from the bottom. AT mines are usually employed in flat ground and roads in order to divert, fix, or disrupt the progress of tanks or vehicles. People inside the vehicle or the tank may also be killed or injured.

Even though the functionalities of AT and AP mines are different, they can be employed in the same field in a mixed configuration so that they reinforce each other.

[13] GICHD, *A Guide to Mine Action*, 8.

[14] Ibid.

Since the TNT inside AT mines can be removed and reused for terrorist acts, after a cease fire, mines still pose a threat as ammunition for terrorist weapons. Whether by design or inadvertently, post-conflict mines can have a horrific impact on its unsuspecting victims, civilians.

TM-57 Metallic Mine

TM-62 P2 Plastic Mine

Figure 5. Anti-Tank Mines[15]

B. HISTORY OF LANDMINES AND DEMINING

> The etymology of the world mine is derived from the Latin *mina*—a vein of core—and was originally applied to the excavation of minerals from the earth. The technique and term were borrowed by military engineers who dug mines during the sieges and packed them with explosive to cause the collapse of fortifications.[16]

Studies reveal that ancient armies used non-explosive landmine-like devices to enhance fortifications for defensive purposes or to change the terrain to their advantage. These weapons were traps, concealed spikes, and stakes.[17] Today, modern mines are explosive traps developed with similar basic ideas but in a more advanced way.

Landmines are one of the oldest weapon systems on earth. The existence of landmines can be traced back 2,500 years.[18] Although the origin of landmines is controversial, the concept has been employed from Roman times to the present day

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[15] GICHD, *A Guide to Mine Action*, 9.

[16] Mike Croll, *The History of the Land Mines*, (1998), ix.

[17] Ibid., 6.

[18] Roger Roy and Shaye Friesen, "Historical Uses of Antipersonnel Landmines: Impact on Land Force Operations," Department of National Defense Canada, (1999): 2.

without modification. “In 52 BC, in the campaign to suppress an uprising against Roman domination, Julius Caesar created elaborate defensive fortifications around the town of Alesia to meet simultaneous threats.”[19] The aim was to provide protection for the defenders while at the same time forcing the attackers to negotiate obstacles and concealed obstructions. The Gauls failed to penetrate the defenses.

These actions showed the usefulness of obstacles. They demonstrated how obstacles can be used to boost defensive strength. Their use in defenses increased the time and resources required to breach defenses, thereby giving an advantage to the defenders. The obstacles also created a buffer zone between the two forces to allow the defenders to remain out of the range of attacking weapons by the attackers. Such phenomena caused the enemy to develop clearing methods to penetrate obstacles and for the defenders to create safe lanes to enable them to launch attacks on a vulnerable flank of the enemy.

Toward the Renaissance, the use of caltrops (early landmines) was widespread during the English War of the Roses among European countries, and caltrops were also used in the United States by early settlers against the Indians.[20] Later, the introduction of gunpowder for military purposes led to the proliferation and gradual improvement of landmines. “The earliest gunpowder landmines were termed fougasses—essentially an underground cannon that was placed in defensive positions to fire rocks and debris.”[21] A fougasse had only a minor effect because it was frequently unreliable. However, a fougasse had the potential to stop a mass attack; it reinforced the main weapon systems and positions of defenders.[22]

It was during the 13th century that modern self-contained explosive AP mines were developed by the Chinese, which they employed against Mongol invaders.[23] These mines were produced with different shapes and sizes, and were activated either with a

[19] Roy and Friesen, “Historical Uses of Antipersonnel Landmines,”2.

[20] Roy and Friesen, “Historical Uses of Antipersonnel Landmines,”3.

[21] Ibid.

[22] Croll, *The History of the Land Mines*, 9.

[23] Roy and Friesen, “Historical Uses of Antipersonnel Landmines,” 3.

pressure or pull-firing device. Europeans also developed mines that were made of black powder and activated by targets when stepped on or by a trip wire. Like fougasse, these devices had weaknesses and required frequent maintenance; therefore, their use was limited to reinforce the defenses of fixed fortifications.[24]

As the operational need for more effective weapon systems increased, new developments in mine technology were needed. The development of AP mines came to reflect the aim of commanders who used them to aid in imposing damage on enemy forces. As a result, modern mines started to evolve in different forms and adapted technologies to fulfill combat needs. Electrically initiated mines, mines with TNT explosives, gas mines, fragmentation mines, air-dropped mines, blast mines, and blast-resistant mines were introduced and widely used all over the world in several wars.

During colonial expeditions and prior to World War I, the British Army used landmines in their campaign in the Sudan and during the Boer War to defend their lines of communication from natives and Boer commandos.[25] British officers believed that landmines were an effective form of defense. In South Africa, mines were laid to protect multiple functions such as defensive positions, communications, and logistical lines.[26] Landmines served as force multipliers.

"Though landmines of various types have been used in warfare almost since the appearance of gunpowder, before the First World War they were improvisations and used comparatively ineffectively."[27] Since the use of AP mines was successful in achieving the intended objective, they added a certain value to warfare. Though mines were unconventional and possibly even uncivilized, they were widely used. They were not decisive to the outcome of a battle, but they helped to delay the movement of enemy troops and to spread fear.

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[24] Roy and Friesen, "Historical Uses of Antipersonnel Landmines" 3.

[25] Roy and Friesen, "Historical Uses of Antipersonnel Landmines,"6.

[26] Ibid., 6.

[27] Ibid., 7.

During the U.S. Civil War and the First World War, the lethality of mines increased due to powerful military explosives.[28] Shells burst into a few high-velocity fragments to kill enemies. However, due to new weapons of the industrial age that gave rise to defensive tactics and technology, the effect of AP mines was minimal. AP mines could not stop a massive infantry attack. Barbed wire, machine guns, and rapid-fire artillery accomplished the task far better than the mines. Nevertheless, AP mines adapted from artillery shells were often laid in abandoned positions in anticipation of an enemy advance. This was to prevent the rapid occupation of defensive positions.

On the massive scale of the First World War, mines were systematically used to increase the burden on opposing forces. Long-delay AP mines were buried in abandoned positions and roads to harass advancing forces. The use of AP mines also caused friendly casualties. "For example, at Givenchy, British mines did more damage to the attacking Canadians than German defenders."[29]

AP mines used in the First World War were not as successful as widely thought due to advanced tactics and technologies. AP mines were laid, but a minefield covered by machine gun fire was sufficient to deter clearance. However, AP mines made the following contributions: delayed the advance of attacking forces, provided defensive barriers, and blocked critical supply routes. AP mines also served as fear-producing agents to demoralize the adversaries.

AP mines had also been used before the introduction of the tank to protect infantry positions from enemy soldiers. However, to overcome new tactics and technologies, AT mines were invented in order to defeat the progress of tanks. In fact, AP mines were used to protect AT mines from enemy breaching parties to ensure AT mines fulfilled their goals.

The use of AP mines during the Second World War saw a growing shift of focus from causing fear or destruction of individual soldiers to a multifaceted anti-personnel

[28] Roy and Friesen, "Historical Uses of Antipersonnel Landmines."

[29] Ibid., 8.

weapon system that stressed a full-fledged concept of area control.[30] This trend was exemplified by the technical improvements that enhanced the effects of AP mines, such as blast and fragmentation effects. These effects were activated by contact, a pressure switch, or a trip wire. This not only increased the lethal effects of AP mines, but it also made the weapon highly adaptable and compatible with the environment in which it was employed. Mines were incorporated into the overall tactical setting, and were constantly updated to defeat countermeasures.

Mines were made reliable, economical, simple and durable, and used standardized sizes and interchangeable parts to ensure compatibility. New types of fragmenting AP mines such as bounding mines and directional mines were introduced. As the threats of mines developed, clearance techniques improved. Therefore, AP mines developed in-phase included measures to complicate hand lifting and thwart electronic detection. Non-metallic mines made from glass, plastic, and Bakelite were invented to overcome the problems of detectability and durability. Towards the end of the Second World War, magnetic-influence, vibration-sensitive, and radio frequency-induced fuses were under development.[31] The use of AT mines in combination with AP mines, dummy mines, and mines with anti-lift devices and booby traps were also used by combatants.

During the Second World War, AP mines were widely used in warfare and they took on a significant role. AP mines demonstrated their utility in delaying advancing forces. In combination with other defenses, they economized on defensive resources and imposed casualties on opposing attackers. The methods of clearance were not able to eliminate this obstacle, and thus the use of the mines proliferated. Mines demonstrated their ability to impose a psychological and moral burden on advancing forces through a fear of the unknown and the inability to retaliate.

Mines were also extensively employed in the Korean War, Vietnam War, Arab-Israeli War, the War in Rhodesia, and more recently in the War in Afghanistan, Iran-Iraq War, Gulf War, and many other civil and guerilla conflicts. In all these conflicts, the use

[30] Lydia Monin and Andrew Gallimore, *The Devil's Gardens, A History of Landmines* (2002), 51.

[31] Croll, *The History of the Land Mines*, 43-48.

of mines has changed somewhat, but is still similar in essence to their role in the major World Wars. Militaries have learned from past experiences and developed new methods to employ mines and to defend against them.

Although the effects of AP mines were never decisive, they complimented other weapons in limited wars and were probably more influential when used in a disruptive manner at strategic points or when used to deny opponents access to an area, rather than used as static barriers. Without creating a great logistical burden, AP mines could be laid rapidly to adapt to terrains, types of forces, and changing tactical situations. This expanded the mine's role from a defensive weapon to an offensive one. Technology-driven armies such as the U.S. could deliver mines behind enemy lines, while guerrilla forces could disrupt conventional armies through the cunning use of AP mines and booby traps.[32] Given different circumstances, mines were unquestionably the most flexible, easily employed, and effective weapon systems of the twentieth century.

Unlike today, in ancient times there was no such thing as demining. A long time ago, sappers used to dig in the ground in their surrounding city walls or fortifications to find the whereabouts of landmines.[33] It was a long, laborious and time-consuming process, and probably the most dangerous military action throughout ancient times. Methods such as the fosse-dry moat or ditch dug down to the bedrock, and wooden walls set on fire were used to counter mines.[34] Starting from the siege of Belgrade to World War I, explosives were used as counter mines to collapse tunnels and destroy laid mines.[35]

The first documented manual breaching (elimination of mines) is thought to have happened in the American Civil War.[36] Sharpshooters were used in an attempt to explode the mines from a distance, and prisoners of war (POWs) were used to find and dig out

[32] Roy and Friesen, "Historical Uses of Antipersonnel Landmines," 42.

[33] E. Donmez, "Mine Clearance Industry," (MBA Professional Report, Naval Postgraduate School, 2007), 37.

[34] Ibid., 39.

[35] Ibid.

[36] Ibid., 40.

mines. Over time, engineers invented other breaching methods that incorporated protective measures. They used tanks to protect demining personnel from blasts in neutralizing buried mines. Towards the end of the First World War, the use of plows was implemented. The French mounted a plow on their Renault FT-17 tank and the British 79th Armored Division employed a "Bullshorn" plow on a Churchill tank at Sword Beach. A more recent implementation is the highly successful full-width mine rake that was first developed and used by the United States during Operation Desert Storm.[37]

"The first formal process of clearance developed immediately after the end of the First World War when the huge number of mines that had been laid during the conflict stood in the way of meaningful reconstruction in Europe."[38] This clearance involved the use of a large amount of manpower, and in many cases the victorious Allies used POWs to carry out the work. France, Germany and the UK used POWs to clear millions of landmines. In the Netherlands, a total of 1,162,458 mines were lifted. Serious causalities were recorded as the result of these efforts.[39]

By the end of the Second World War, Europeans had cleared more than 90 percent of their landmines. The clearance was conducted through the implementation of simple techniques adapted from military doctrine and was executed by experienced military personnel. The techniques were based on prodding and metal detectors. The average number of mines cleared per casualty was 3,279 mines.[40] Even though the causality rate was reduced over time, the fundamental methodology for manual mine clearance remained the same for the next 50 years.[41] Evidence of the evolution of manual mine clearance procedures, administration, and techniques are revealed through the convergence between manual military mine clearance and civilian/humanitarian

[37] Donmez, "Mine Clearance Industry."

[38] GICHD, *A Study of Manual Mine Clearance*, (2005), 17.

[39] Ibid.

[40] Ibid., 18.

[41] Ibid.

demining. Even though there have been some minor changes in the application of mine clearance for humanitarian purposes, the fundamental technical principles remain unchanged.[42]

Landmine clearance for humanitarian purposes originated in Afghanistan by the UN-led resource mobilization for demining in 1988.[43] Evidence reveals that prior to this period mine clearance was basically the work of national militaries. "At the time the UN appeal for the funds was for "humanitarian demining," a new term which was understood to mean not only the removal of emplaced mines but also informational and educational activities to prevent injuries. "The term 'demining' was used to denote mine clearance for humanitarian purposes and to distinguish it clearly from the military activity of 'breaching', which cleared paths through minefields to attain military mission objectives."[44]

Later, a number of NGOs were created to survey, map, mark and clear landmines and UXOs, and to conduct mine awareness training for the civilian population. As a result, the year 1988 gave birth to the world's first international humanitarian mine clearance NGOs: Hazardous Area Life-Support Organization (HALO Trust) and Mines Advisory Group (MAG).[45]

In addition to the creation of new NGOs, there were other NGOs such as Norwegian People's Aid (NPA) which were involved one way or another in mine clearance for humanitarian purposes. Commercial companies were also involved in the clearance of landmines that originated in Kuwait and have since shown dramatic growth. Commercial companies, such as BACTEC, European Landmine Solutions, Mechem, Mine-Tech and Royal Ordnance, have played a significant role in humanitarian demining.[46]

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[42] GICHD, *A Study of Manual Mine Clearance*.

[43] GICHD, *A History of Mine Action*, (2004), 21.

[44] Ibid.

[45] Ibid.

[46] GICHD, *A History of Mine Action*, 22.

After the programs in Afghanistan and Kuwait, Cambodia created the Cambodian Mine Action Centre (CMAC) in 1992.[47] This was due to the need for the repatriation of refugees and displaced persons from Thailand. The UN Security Council expanded the mandate of the UN Advance Mission in Cambodia (UNAMIC) to include mine clearance and training. Following this, planning for mine action in Mozambique began just after the UN had appointed an expert to the Department for Peacekeeping Operations (DPKO) to focus on landmines and to set up the UN Demining Office.[48] In addition, national programs were increasing in size and scope and new programs were being set up at a rapid rate. Thus, programs were set in place in Albania, Bosnia and Herzegovina, Croatia, Kosovo, the Former Yugoslav Republic of Macedonia, and northern Iraq to deal with the resultant mine and UXO dangers.[49]

With the increased number of demining national organizations, NGOs, commercial companies and the UN, the need for standardization prevailed. Consequently, in July 1996, international standards for humanitarian mine clearance programs were proposed by working groups at an international conference in Denmark.[50] Criteria were prescribed for all aspects of mine clearance, standards were recommended, and a new universal definition of "clearance" was agreed upon.[51] At the same time resources for humanitarian demining started to flow. U.S. $85 million in funds for mine action were pledged, with some U.S. $20 million being directly earmarked to the newly-established UN Voluntary Trust Fund for Mine Clearance.[52] Over time, improvements in the standardization of mine clearance continued and pledged funds increased.

The ongoing mine action resulted in the development of professional standards. . As funds continued to flow the need for cost-effectiveness analysis and to monitor and evaluate performance became significant. The need for sustainability of demining

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[47] GICHD, *A History of Mine Action*, 22.

[48] GICHD, *A History of Mine Action*, 23.

[49] Ibid., 24.

[50] Ibid., 22.

[51] Ibid., 23.

[52] Ibid.

programs, linking mine action to economic development, and various socioeconomic benefits dominated the international discussions. The mine action community offered alternative ways to satisfy demand. Hard lessons were learned and many mistakes were made, but the willingness of mine action professionals and institutions to learn from successes and failures and the generosity of donors are driving the future evolution of the mine action discipline.

C. PAST STUDIES ABOUT LANDMINES AND DEMINING

Due to their military importance in defense and later use for offense, mines have been utilized widely in almost all the major wars of the world. Until recently, the techniques and systems developed were on how to advance the strategic capability of landmines. With advances in their lethality came the increased need to remove landmines for the safety of the combating troops through the use of explosives, blast harnesses, tanks, plows, and other breaching mechanisms. However, the mechanisms developed were for the benefit of the military and mostly limited to the duration of the war.

A few decades ago landmines finally became notorious for their unintended consequences. While landmines provided military defense capabilities, they also became known for killing and maiming innocent civilians and for hampering economic activity by restraining the movement of people, and creating widespread fear after the cessation of hostilities. Mines used in the larger wars were largely dealt with after the end of those wars. For example,

> In the clearance of the Netherlands in 1945 and 1946, some 1.16 million mines were cleared in total. Although the historical data are difficult to interpret reliably, a British government report on the mine clearance operation in the Netherlands outlines the details of an operation undertaken by the German *Dreager* brigade between 12 July and 19 October 1945. It used 279,325 operational man hours of work to clear 450,125 mines.[53]

As more of the strategic military importance of mines was discovered by combatants, their fabrication and use increased dramatically. As easy as they are to

[53] GICHD, *A Study of Manual Mine Clearance*, 19.

transport and cheap to buy (it is estimated that landmines cost as little as $3 to produce),[54] mines started to be used by guerilla fighters in domestic conflicts for shorter and temporary tactical uses. Mines were employed by guerillas to block pathways of government troops in close proximity to areas used by civilians. After the conflict, the mines were neither cleared nor recorded by the fighters. Thus, they became a significant problem.

This created a devastating effect since the location of landmines remained a mystery. After cease-fires, people who fled the war were killed in their attempt to return. Aid workers could not supply aid to the needy since landmines put their lives in danger. Peacekeeping operations and rehabilitation programs became more difficult and costly. It was after this realization that the humanitarian and developmental impact of landmines began to receive attention. Scholars finally began to study the impact of landmines on economic development and reconstruction.

The strategic benefits of landmines may have declined relative to the effect they have on economies after the cessation of hostilities. This was observed during the Iraqi invasion of Kuwait. The extensive landmines laid could not protect the Iraqi soldiers from coalition forces. The two reasons were that coalition forces were able to breach the minefields with new technologies and that the Iraqis failed to patrol their mines. This suggests mines are not the standalone strategic weapons they used to be in the past. As a result, military benefit of landmines has declined compared to the impact they later inflict on an economy. It is with this point in mind and in recognition of the devastating effects of landmines on humanity, that nations of the world joined together to create the Ottawa Treaty in 1997.

Since the signing of the Ottawa Treaty, the world has given serious attention to the alleviation of the impact of landmines. Various organizations were created to deal with the removal and broader impact of landmines. Demining and mine risk education along with other supportive programs were established and encouraged by donors. Even though the programs dealing with landmines towards the beginning were dealing with the

[54] United Nations Association of the United States of America Web site, http://www.landmines.org/Page.aspx?pid=789 (accessed May 29, 2009).

thought of saving lives, later, with the help of different studies, the mine action community started to perceive the importance of an overall integrated approach to economic development and reconstruction. As a result, the struggle against landmines these days is perceived as both a humanitarian and economic development issue.

Recently, with the existence of competing humanitarian emergency issues, donor and mine action communities have started to question the benefits of removing landmines. If the landmines are not in a position to kill, should they be removed? What exactly is achieved by removing them? Is saving lives enough to justify clearing landmines or do other variables exist? What are the sufficient conditions for removal? Based on these types of questions/doubts, studies have attempted to address these questions.

Some scholars such as Gildestad, Elliot and Harris, and Mitchell and Peterson have conducted studies and supported their views with surveys from different countries.[55] Some studies recommend that landmines be removed, while others do not see an economic benefit to removing landmines. Some argue the benefits from demining are larger than the costs and so landmines should be cleared, while others argue the costs outweigh the benefits so other options besides demining should be explored.[56]

In fact, some see the impact of landmines in isolation to the obstacle they impose on development. They also perceive it as a short-term emergency problem and ignore the potential of the obstruction to economic development. The difficulty to quantify the benefits of demining and the ignoring of intangible benefits might contribute to the difference. The positive thing is that there are many helpful studies that provide insight on landmines and demining as well as the associated impacts. Having said that the authors believe that there are a number of unstudied and yet to be covered issues that can provide better insight to the subject.

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[55] John Gibson, Sandra Barns, Michael Cameron, Steven Lim, Frank Scrimgeour, and John Tressler, "The Value of Statistical Life and the Economics of Landmine Clearance in Developing Countries," (2006): 512.

[56] Ibid.

Some studies examine the impact of landmines independently of the obstacle they impose on economic development. They also perceive it as a short-term emergency problem. The challenge is to quantify the benefits of demining and to capture all the relevant costs and benefits. Few scholars examine alternatives to the removal of landmines when removal proves to be uneconomical. For example, when demining is estimated to be too costly, other options such as permanently marking or fencing and relocating the population could be explored. However, it is not clear how these alternatives can be assessed. For example, should the mines be left forever by marking or fencing them? What are the relevant benefits from demining and over what time period should the benefits be measured?

The value of a location will be different once it is demined. Could it pay a landowner to invest privately in demining to increase the value of their land? There is good understanding of the threat of landmines, but no clear direction on the appropriate approaches to alleviate their impact.

As awareness of the impact of landmines increases, donor communities are providing more funds to the industry. As a result, hundreds of organizations working around mine actions have been created. An important question is whether this increase has helped alleviate the problem. Has the competition for funds created innovation or simply resulted in non-value added lobbying and rent seeking? How should donations be invested to contribute to the development of new ways to increase the benefits of demining? This study attempts to address some of these important questions.

III. STRUCTURE AND FINANCE OF DEMINING

A. ORGANIZATIONS DEALING WITH LANDMINE PROBLEM

Currently, academic organizations, corporate firms, UN agencies, government agencies, international organizations, mine action centers and national demining organizations, military organizations, and local and international NGOs are all part of the mine action industry dealing with the landmine problem (a list of all categories is provided in the Appendix at the end of this study).

Even though the post-conflict impact of landmines has been recognized since their initial use, demining is a comparatively new business which started in earnest in Afghanistan with the support of the UN in 1998. The increase in demand by mine-affected countries and the rise of donors to support the alleviation of human suffering due to landmines is said to have contributed to the expansion of organizations supplying mine actions.

Several different alternatives can be considered to alleviate the impact of landmines. These can be categorized as longer-term and shorter-term solutions. A longer- term solution can be an Ottawa Treaty-type agreement which prohibits member states from using, producing, or cooperating in the use of landmines, and calls for member states to destroy their stockpiles. Encouraging non-member states to sign such a treaty would reduce the risks posed by landmines.

If states cannot sign the treaty or respect the rules to use their mines in a way that will not cause harm to civilians and obstruct economic development, then other solutions need to be considered. Such solutions could include developing self-destructing mines or mines with RFID tags that can be secretly tracked, or increasing their cost to reduce the quantity demanded, or making them short-lived.

Shorter-term solutions include demining, marking, fencing, or the relocation of the population. Unfortunately, if demining takes place and conflicts resume, then demining may prove only a temporary option. . Similarly, if land is fenced for safety

reasons so that people will not use it, after some period of time the land may increase in value to the point it becomes cost-effective for landowners to demine. Short-term solutions must be accompanied with longer run analysis.

There are many organizations involved in the industry to alleviate the impact of landmines worldwide. Some initiatives occur locally conducted by the mine- affected countries and others occur outside by the international community such as the NGOs, UN, donor communities, and others. The attempt of poorer countries to deal with the impact of the landmines alone is insufficient as most do not have sufficient resources or capabilities. Therefore, a lot of international organizations are widely represented in mine-affected countries joining in the struggle against landmines.

Organizations such as the International Campaign to Ban Landmines (ICBL), NGOs, and others are encouraging states to sign the Ottawa Treaty and trying to ensure that signatories respect the rules of the agreement. National mine action centers, military demining units, and local government agencies deal in planning, prioritizing demining activities, monitoring, coordinating, fund raising, mine risk education, and other relevant activities.

Organizations like the UN assist mine-affected countries in fund raising, consulting, capacity building, equipment purchases, and monitoring and evaluation as well as quality assurance. The main organizations dealing in mine actions are the United Nations Mine Action Service (UNMAS), the United Nations Children's Fund (UNICEF), the United Nations Development Program (UNDP), and the United Nations Office for Project Services (UNOPS).

Various NGOs participate in demining, mine risk education, advocacy, providing prostheses, capacity building and resource mobilization. Commercial companies participate in landmine clearance and mine risk education training and consulting. Organizations like the Geneva International Centre for Humanitarian Demining (GICHD) support other organizations technically, promote technologies, advocate for the Ottawa Treaty, raise funds, and host international consulting and experience exchange meetings.

Corporate firms produce equipment and invent new technologies to supply the demining organizations. Academic institutions train management and conduct research to advise the relevant bodies.

There are many organizations involved in the industry to alleviate the impact of landmines worldwide. The various activities are dealt from inside locally by the mine-affected countries and from outside by the international community such as the NGOs, UN, donor communities, and others. The struggled attempt against the impact of the landmines by the mine-affected countries alone is insufficient as most do not have the resources and capability to do so. Therefore, a lot of international organizations are widely spread in the mine-affected countries to join the struggle against the impact.

Every organization operating in the industry more or less follows the standard operating procedure (SOPs) developed by the UN. These standards are important to ensure the quality of land cleared, to choose the right equipment that allows the standards to be met, to employ proper assets and to understand which ones are accepted, and to create an understanding in handing over of the land to end users when the required work is finished. SOPs protect against the involvement of organizations in demining that do not have the proper skills and necessary equipment. SOPs also serve in a similar fashion in mine risk education. There are a lot of opportunities to share experience created by the UN, NGOs, GICHD, and others that assist in the introduction of new methods and development opportunities.

The fact that there are so many governmental, non-governmental, commercial and UN agencies involved in mine actions demonstrates the availability of funds and interest in demining. Occasionally, innovations have surfaced such as the use of mine detection dogs (MDDs) and machines to support manual demining. Newer and improved metal detectors are being manufactured. The efficiency of demining is increasing and the cost-benefit approach, linking demining to economic development is being implemented. Building reputations and the competition for donations play an increasingly important role and are contributing to the improvement of demining.[57]

[57] ICBL, "Landmine Monitor Report Executive Summary," (2008): 53. http://www.icbl.org/lm/2008/translations/LMES_2008_07_withMaps.pdf (accessed May 29, 2009).

On the other hand, even given the number of organizations involved in mine actions, the slow reduction in the threats posed by landmines suggests that there is still a long way to go. There are a lot of countries such as Angola, Cambodia and Mozambique that started demining over twenty years ago and that still have not achieved their goals. There are international NGOs that are involved in mine actions with the intent of reducing the impact of landmines and building capacity of the local facilities of the mine-affected country. There are commercial companies that are unwilling to work on very difficult minefields and there are organizations that depend only on commercial companies for contractual reasons such as insurance. Moreover, many organizations secure their own financial resources from their own country. Therefore, competition may be less intense than first appears.

The involvement of the UN in mine actions has not only paved the way for an important role for the initiation of the programs but has also helped in monitoring, evaluation, fund raising and quality assurance. However, it is not clear why there are four branches involved in mine actions instead of one or two. This raises question of efficiency and effectiveness posed by the possible redundancy. The numbers of non-profit organizations, such as NGOs, and governmental organizations dealing in demining are greater than the number of commercial companies, and even with this intense competition, many nonprofit organizations are still flourishing. This is because the cost and quality of demining are not explicitly evaluated. This suggests the importance of measuring performance in the mine action industry.

There are many organizations that started as rehabilitation programs, education, emergency relief, food security, and other economic development organizations that later have included mine action activities as they see a potential new revenue source . However, superior results in terms of cost and effectiveness might be achieved if mine action were done competitively by agencies based on their comparative advantage.

In general, organizations involved in mine actions are playing an important role in alleviating the impact of landmines and contributing to the long- and short-term solutions of the problems imposed in mine-affected countries. There is still room for improvement in the execution, coordination, efficiency, effectiveness, innovation, and proper

utilization of resources as well as promoting competition in mine action activities. Some duplication of work should be avoided to increase effectiveness and to save resources from being wasted, and the role of Military institutions could be explored.

B. FINANCE OF DEMINING

Most mine-affected countries are developing nations. This is not to say developed nations do not have mine problems, but they are generally able to address the impact with minimal outside assistance. However, developing nations rely on outside support both in capability and resources to alleviate the problems posed by landmines. The outside support mostly comes from developed nations. Therefore, this by itself makes landmines a global problem in addition to the impacts landmines impose on trade relations and markets across borders, as well as denying access to valuable resources.

Even though the responsibility of resolving the landmine problem can be thought to belong to the mine-affected countries, in reality the affected countries generally do not have enough resources and capabilities to resolve it alone. Moreover, landmine impacts are not limited to the mine-affected nations, but also affect the world economy. Landmine problems have not only been caused by the affected nations. Directly or indirectly, many actors are involved. The producers, shippers, brokers, and users of landmines all contribute to the problem. This involves the international community. However, mine-affected nations must take the initiative to fight against the risks posed by the landmines. A borderless approach coupled with a humanitarian view by the international community has paved the way for a global, joint effort in the struggle against landmines.

Nations contribute to the fight against landmines in various ways. One important joint effort in the fight against landmines is the gathering of nations under the umbrella of the Ottawa Treaty. This treaty has raised the significance of landmines among states, creating coordination mechanisms that bind nations into a collaborative effort to eliminate the use of landmines. Though the Ottawa Treaty aims at a long-run solution, it also obligates states to remove their landmines:

> Each States party in a position to do so shall provide assistance for mine clearance and related activities. Such assistance may be provided, inter alia, through the United Nations system, international or regional organizations or institutions, nongovernmental organizations or institution or in a bilateral basis, or by contributing to the United Nations voluntary trust fund for assistance in mine clearance or other regional funds that deal with the demining.[58]

Resources for mine actions can be provided in the form of equipment, technical assistance and training, managerial assistance, resource mobilization assistance, etc. The most common ways that the resources are provided are as follows:[59]

- International aid funds
- In-kind support from international aid donors
- Direct host government support and funding
- Indirect host government funding
- The use of military personnel in demining operations
- Other wealthy donor governments
- The United Nations or other international organizations
- Benefactors and philanthropists

Donations are not only limited to the aforementioned ways; there are other approaches such as fund raising by private individuals and from the public in campaigns by NGOs or demining organizations. The international community has contributed extensively to alleviate the impacts of landmines. Although there is a shortage of data, especially when it comes mine-affected nation's contributions, the international contribution for mine actions from 1992 to 2007 was $3.75 billion.[60] Countries that contributed to these donations included the United States, Norway, Canada, European Commission, Japan, United Kingdom, Netherlands, Germany, Sweden, Australia, Denmark, Switzerland, and many others as shown in Figure 6. It has been noted that

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[58] The Ottawa Treaty, "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel Mines and on their Destruction," Article 6.4, (1997).

[59] James Trevelyan, "The Mine Action Process," *Journal of Mine Action*, The University of Western Australia. http://maic.jmu.edu/journal/4.3/process.htm (accessed May 13, 2009).

[60] International Campaign to Ban Landmines. "Landmine Monitor Report Executive Summary."

contributions to most mine-affected countries by the international community has been immense compared to the effort of the national community. This can be highlighted by incapacity of the affected nations to sustain these efforts. International mine action funding for 2007 was $430.67 million while national mine action funding for 2007 was $117.4 million.[61]

International Funding

Donor	US$ (million)	€ (million)
US	69.8	50.9
Norway	50.2	36.6
Canada	45.8	33.4
EC	45.6	33.3
Japan	35.5	25.9
UK	25.2	18.4
Netherlands	23.4	17.1
Germany	18.4	13.4
Sweden	17.5	12.8
Australia	16.7	12.2
Denmark	12.1	8.8
Switzerland	12	8.8
Spain	11.7	8.6
Belgium	10.8	7.9
Slovakia	9.6	7
Ireland	7	5.1
Finland	5	3.6
Italy	4.1	3
France	2.4	1.7
New Zealand	2	1.5
Czech Republic	1.2	0.9
Austria	1.2	0.8
South Korea	1	0.7
Luxembourg	0.9	0.6
China	0.8	0.6
Slovenia	0.7	0.5
Lithuania	0.07	0.05

National Funding

Donor	US$ (million)	€ (million)
Croatia	45.7	33.3
Iraq	18.2	13.3
BiH	13.7	10
Sudan	7.5	5.5
Lebanon	5.5	4
Yemen	3.5	2.6
Jordan	3.5	2.6
Thailand	2.7	2
Chad	2.5	1.8
Azerbaijan	2.2	1.6
Colombia	1.3	1
Mozambique	1.3	0.9
Chile	1.2	0.9
Cambodia	1.2	0.8
Nicaragua	1.0	0.7
Zambia	1.0	0.7
Senegal	1.0	0.7
Peru	0.9	0.7
Mauritania	0.8	0.5
Tajikistan	0.6	0.4
South Korea	0.6	0.4
Ecuador	0.5	0.4
Uganda	0.3	0.2
Afghanistan	0.3	0.2
Egypt	0.3	0.2
Albania	0.2	0.2
Rwanda	0.06	0.04
Zimbabwe	0.01	0.007

Figure 6. International Funding vs. National Funding in 2007

Most commonly, resource mobilization for mine actions is coordinated by committees or groups. The Mine Action Support Group (MASG) established in 1998 by the 27 donor countries attempts to coordinate the humanitarian mine action programs of the world's major donor states, to harmonize the prioritization of their respective mine

[61] International Campaign to Ban Landmines. “Landmine Monitor Report Executive Summary.”

action programs and to increase donor support for mine actions where most needed.[62] MASG is chaired by alternating country representatives and meets three times a year.

The steering committee on mine action chaired by UNMAS's director includes twenty four donor states and meets biannually. The mine ban treaty's Resource Mobilization Contact Group (RMCG) is led by Norway. This group reports the need for assistance and secures fund to comply with the mine clearance deadlines of the treaty by the state parties. Funds mobilized through these coordinated groups or committees are channeled to the mine-affected countries through the UN and NGOs bilaterally or multilaterally, directly or through third parties, and/or through other means.

The mine-affected countries can also appeal for mine action support through the UN, jointly with NGOs, and directly to the donor countries for bilateral and multilateral assistance. In most cases, mine action funds are donated either through the UN or NGOs. It is rare that donors give funds to the mine-affected country's government directly for mine action purposes. This usually is in recognition that local governments might serve political interests before the intended public use. However, there is military-to-military cooperation and bilateral assistance delivered to mine-affected states, including World Bank loans. The European Union also gives donations directly to the mine-affected governments.[63]

It is obvious that mine actions through donations is not sustainable. Donors cannot provide money forever. In fact, some donors retreated or decreased their funds already due to fatigue and the global financial crisis. For example, France decreased its funds in the last three years from $3.8 million to $3.3 million and then $2.4 million, respectively.[64]

The sustainable solution to mine action could be to build the capacities of mine-affected countries and to empower them to be able to resolve their problems domestically. However, this is not easy as it also depends on donations. Donors become

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[62] United States Department of State Web site, http://www.state.gov/t/pm/wra/c17719.htm (accessed May 13, 2009).

[63] International Campaign to Ban Landmines, "Landmine Monitor Report Executive Summary."

[64] Ibid., 59.

reluctant to assist in countries where conflicts are ongoing, and their interest fades after continuous support for quite some time. Donors also retreat or decrease their donations when mine-affected countries do not comply with conventions and treaties such as the Ottawa Treaty. For example, the United States was the only foreign donor to provide aid in funding, equipment, logistical support, and explosives training, with a total of US $14.2 million in mine action assistance to Rwanda during 1995 to 2000, but U.S. funding for Rwanda stopped in 2001.[65]

When diplomatic relation problems occur, donors can cut off funds. Some donors are also dissatisfied when local governments do not take initiatives in resolving their mine problems. Recipient countries also mishandle resources, which causes donors to retreat. Donations for mine actions also decrease with the advent of other crises because donors, partially or totally, shift funds to the new programs. Moreover, a lot of donors place limitations, conditions, restrictions, and prefer to be more involved in the process. In such situations the recipient countries feel constrained, which can ultimately lead to dissatisfaction by both parties. In each case, mine action funds can be threatened.

Funds for mine actions for individual countries are decreasing over time. Even though figures seem to show overall increases, in reality funds for individual countries are declining.[66] The reason for this is that new mine-affected states have appeared recently, namely Iraq, Lebanon and Afghanistan (now on a larger scale). Meanwhile, there are countries still demining after twenty years and donors are tired of continuously providing funds. For example, Cambodia and Mozambique started their mine action program in 1992 and are still clearing landmines in their territories.[67] Funds are decreasing compared to the growing number of states and countries are requesting new programs as they see the potential to attract funds.

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[65] IRIN Humanitarian News and Analysis, "Rwanda: Funding shortage retards mine action efforts," http://www.irinnews.org/InDepthMain.aspx?InDepthId=19&ReportId=62839&Country=Yes (accessed May 13, 2009).

[66] International Campaign to Ban Landmines, "Landmine Monitor Report Executive Summary."

[67] GICHD, *A History of Mine Action*, 22.

The improvement in the data gathering of donations, especially for the mine-affected states, contributes to the elevated figure. Of all the funds appealed by the UN, mine clearance projects received nearly half (48 percent) of the funds in 2006.[68] In 2008, mine clearance projects received 56.47 percent of the funds.[69] The growth is due to the emerging crises in Lebanon, Iraq and other countries. It is worth mentioning that collecting data about mine action donations from donors is difficult, and even more complex to gather from the recipient countries.[70]

Though funds for mine action are decreasing for individual countries, they still account for a significant portion of the humanitarian and development aid that is donated. It is important to bear in mind that fund requests are inflated by the resource mobilizers due to their wishes for more funds. However, what is most needed in mine action is the wise use of the available resources.

As most landmines are inherited from international and/or national military conflicts, it is the military that is expected to have the best information on the mines and their location. Organizations that demine in a mine-affected country rely on the military for information. Directly or indirectly, the military often provides the source of the skills required to remove landmines.

To date most civilian demining organizations such as NGOs, the UN, and governmental organizations have dependable, skilled personnel that are either retired military or on loan from the military. The majority of demining organizations are not military but civilian institutions. This has to do with restrictions, preferences, and limitations of the donor community and is mainly due to the misperception that militaries are un-trusted institutions to work in a humanitarian business. However, given that militaries are well-informed and possess both discipline and skills, the involvement of the military in demining could save a lot of resources. It might be useful to leverage existing institutions and capabilities.

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[68] 2006 U.N. Portfolio End Year Review, (2007): 2, http://www.mineaction.org/downloads/1/1EYR%20narrative.pdf (accessed May 13, 2009).

[69] UNMAS, "Portfolio of Mine Action Projects," (2009): 431.

[70] International Campaign to Ban Landmines, "Landmine Monitor Report Executive Summary."

It is important that funds be distributed to the needy in a coordinated fashion so that demining programs continue without interruption. It is also important to have a coordinating body that monitors funds and the use of those funds and results.

For example, most funds for mine actions are channeled through the UN. The UN mobilizes resources and distributes those funds to the needy based on requests, approvals, and the availability of funds. A lot of work is involved to deliver funds, monitor the execution of those funds, provide feedback to the donors, and coordinate the flow of information. If this process does not occur smoothly, then funds can be wasted before they reach their target.

The UN has a lot of branch institutions such as the United Nations Voluntary Trust Fund for Assistance in Mine Action (VTF), the United Nations Central Emergency Response Fund (CERF), UNDP, UNICEF, Adopt-A-minefield, and UNOPS dealing in mine action.

Because NGOs are perceived as impartial by the donor communities, they receive a considerable portion of total demining donations. A majority of the NGOs receive their donations from their original country. NGOs work abroad in developing countries with the intent of reaching out and building sustainable capacity. Unfortunately, this has not been a success in most mine-affected countries.

The NGOs in demining need to mobilize resources to support their program and this job can only be conducted from accessible areas. It is not uncommon for NGOs to leave jobs partly completed when funds are deteriorating. Even if they have not completed their missions, most donors will not continue their funding after the NGOs leave. Also, many NGOs have still not transferred their knowledge and capabilities to the local population after more than ten years. For example, the HALO Trust has been working in demining in Cambodia since 1991, and NPA since 1992. This cannot be because demining is a difficult task or requires unique knowledge that needs to be learned by the locals, but it is due to resources that will run out after they leave. This adds to the cost of demining, thereby creating a burden on donors.

Mine-affected countries sometimes see the funds for demining as an opportunity to obtain an income stream and as a means to create jobs. Therefore, they can tend to exaggerate their problems in order to obtain more funds. Unfortunately, the NGOs, the UN, and the public of the mine-affected countries might encourage such exaggeration because it serves them in the same way.

However, creating jobs is not the same as creating wealth. The only way to create wealth is to move from a lower-valued use to a higher-valued use.[71] Moreover, most mine-affected countries do not seem to come forward to take the initiative and demonstrate that they can take over the job. This might help to avoid the donor fears of paying locals for various tasks involved in demining.. Instead, the bulk of donated funds go to expatriates.

A study on demining operations reveals the cost of an expat deminer is $75 per hour while a local deminer costs $2 per hour.[72] The skill/productivity differential does not appear to justify such a dramatic difference in wages. This is not to say an expat's skills are not required at all. If mine-affected states could contribute a reasonable amount of their own funding to demining, this might provide a credible commitment to donors and might build confidence for donors to finance the countries directly.

To avoid the danger posed to deminers at work and to protect the safety of end users of the land, a series of safety measures have been developed. These safety measures are one of the biggest reasons that demining is so costly. Most mine-affected states are underdeveloped, but the standards for demining are developed by the developed countries at their level of safety. However, it is impossible to impose the safety of developed countries on developing nations without jeopardizing available resources.

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[71] David R. Henderson, "The Ten Pillars of Economic Wisdom," in *The Joy of Freedom: An Economist's Odyssey* (Upper Saddle River, NJ: Prentice Hall, 2001), 26.

[72] Steven Buc and George Tillery, "Cost and Effectiveness Modeling for Demining Operations," (1996): 38.

The fact is that people in developing countries are used to living with higher risks than those in developed countries.[73] Thus, if the standards of demining could be set to the tolerable safety levels of the mine-affected nations, this would save significant expenses now spent on rigorous safety measures. In fact, this is likely to slow down demining efforts. The slower the demining the more people will be killed from mines, especially in relatively unaccessible places. The ultimate use of the demined land and the end users' risk tolerance are important factors that need to be considered in defining demining standards.

The way that donors pledge funds for demining is based on the appeal of the proposal presented to them. As long as donors continue to extend their hand, there are many waiting to take their share. What is currently seen happening are states emerging with new problems and requests for funds. For example, Burundi has established its mine action program recently; Cambodia and Angola are still working in demining for decades. Demining organizations continue to cooperate since their jobs depend on it. Donors can change these perverse incentives by rewarding efficient organizations and countries that finish ahead of others. There should be incentives for completing projects rather than for exaggerating the problem. The irony is that once a country declares it is finished, it gets nothing. This encourages the mine-affected countries to extend the problem and job of demining. Therefore there may be negative externalities in seeking demining funding which should be addressed.[74]

The longer-term solution approach of landmine problems through the Ottawa Treaty is a noble idea. However, this idea is not supported by the major powers like the U.S., China, and Russia. This may affect the success of the treaty and if it fails, the economic and human impacts of landmines will continue to plague different parts of the world. The treaty is also an agreement that is highly dependent upon the willingness of the signatories to abide by their obligations in the treaty. If they do not cooperate, there is

[73] Third World Traveler Web site. http://www.thirdworldtraveler.com/Landmines_html/DeadlyHiddenKillers_CDI.html (accessed May 29, 2009).

[74] "An externality is an activity of one entity that affects the welfare of another entity in a way that is outside the market mechanism." Harvey Rosen and Ted Gayer, *Public Finance*, (2008), 71.

no enforcement mechanism. Therefore, if the treaty included the possibility of sanctions (or rewards), it might be more likely to be fully implemented by all parties.

In general, the generosity of donor countries and the willingness of state parties to alleviate the impacts of landmines through collaborative joint efforts are noble. The signing of the Ottawa Treaty to eliminate landmines once and for all is a long-run solution that all countries of the world should agree upon. This would save human lives as well as development costs and funds that are spent on mine actions.

However, because the problems posed by existing mines still need to be addressed the need to fund demining efforts should not be forgotten. Thus, the systematic and best use of donor funds should be encouraged. There should be accountability and procedures developed to ensure that the funds that are intended to support mine-affected countries are reaching them. There must be a mechanism to follow up to see if the resources spent have the desired results. Donors need to realize the implications of any restrictions, limitations, or special preferences placed on their donations. Finally, mine-affected countries must step up and take the initiative and lead in a transparent and accountable manner with any foreign assistance whenever possible to help resolve their own problems.

IV. ECONOMICS OF LANDMINES AND DEMINING

A. ECONOMIC IMPACT OF LANDMINES

Landmines, left after ceasefires or cessation of hostilities by conflicting parties throughout the world, are dangerous, pose significant threats to humans and livestock, and interfere with social and economic development. Landmines put tremendous burdens on post-conflict host nations. They undermine food security by denying access to farms, grazing lands, water, and forests for fuel (wood) and foraging for food. The treatment and rehabilitation costs for a landmine victim are devastating. The inability to repatriate refugees and settle internally displaced people (IDP) limits opportunities, which reduces a nation's human capital. The obstruction of the rebuilding of infrastructure caused by landmines in conflict-torn nations is a key impediment to economic growth.

Landmines are inexpensive and easy to forget when a war is over. As they often are not marked and stay for long periods underground, they become very hard to deal with and weigh even more heavily than their intended use. According to landmine monitor reports over several years, "landmines in Afghanistan left 88 percent of land unusable. In similar reports landmines in Angola reduced food security by more than 25 percent."[75] Landmines are serious threats to the long-term development and post-war recovery of a host nation. Overall, the unintended impact of landmines outweighs the intended impact, and that is why they need to be banned. To better understand and analyze the real impacts of landmines, the major impacts of landmines on a mine-affected host nation's overall economical, social, and environmental development are listed. Also discussed is the effect landmines have on the global economy.

In summary, landmines:

- Kill or maim human beings
- Prevent the utilization of farmland
- Impede the repatriation of refugees and settlement of IDP

[75] Ouarda Merrouche, "Landmines and Poverty: Evidence from Mozambique," Peace Economics, Peace Science and Public Policy, (2008): 1.

- Affect the environment by destroying the ecological system
- Are lethal to livestock
- Disrupt markets and trade
- Discourage potential investment and tourism
- Prolong or hinder reconstruction
- Deny access to infrastructure

1. Kill or Maim Human Beings

Most mine-affected countries are poor nations. Landmines seriously affect the economies of these mine-infested nations by killing and maiming people and undermining human capital development. In a post-conflict attempt at recovery and demand for growth, people wander for survival, resumption of new lives, and reconstruction in the war-torn country. Landmine injuries prevent people from earning income to support themselves and their families. Injuries and deaths from landmines also impact the economy and the social structure of the host nation.

As in most poor nations, women collect fire wood and fetch water. Children herd cattle or travel long distances to school and may come across mines. Women, in their attempts at survival, may be killed or injured. In their struggle to support their families, men work in farming. Therefore, their attempt to plough and harvest in mined areas may get them killed or injured. Accidents also occur when attempting to salvage the metal casing of a mine to sell as scrap metal for income. As the women are very important in a household to maintain the family, when they are killed or injured the family scatters. In various surveys, it is found that a majority of injured women lose their chance at marriage, or if married, are deserted by their husbands because of their injuries.[76] If a man is injured or killed this means the family is often left destitute. If children are killed or injured this undermines the productivity of future generations.

The impact of landmine victims goes beyond personal and household impacts. A mine victim needs medical care and medical devices like prostheses and/or wheelchairs.

[76] Daya Somasundaram and Kea Renol, "The Psychological Effects of Landmines in Cambodia," Royal University of Phnom Penh, Cambodia, (1998): 230.

Therefore, with an increased number of victims the victims absorb the limited medical resources available, fill up the beds in hospitals, and cause a great burden of expense. For example, a field survey in Afghanistan reveals

> The significant financial impact of landmine accidents on mine victims and their families. Victims' families spent a total of $197,880 on accident-related expenditures. The average expenditure per family was $338. Eighty-seven percent of the families of survivors went into debt because of the accident. Fifty-six percent had to sell assets to pay for medicines, transportation, treatment costs, food during treatment, and blood. The impact transcends the time of treatment. Unemployment for adult males rose from 6 percent to 54 percent as a result of a landmine incident.[77]

Even after victims are cured, they may not be productive. Rather, they may become dependent on society and drift to bigger cities and become beggars. If an adult person is killed, he/she leaves dependents behind. These dependents are a burden to the countries in which they reside. The more people killed the more the human capital of that country is affected and its economy hurt.

People who see one of their family members and/or neighbors injured or killed by a mine are often scared and traumatized. As a result, people are depressed and less productive. The person injured is psychologically damaged and depressed as well. Such trauma will remain in the society and affects social behavior.[78] Therefore, landmines impact a post-conflict recovery in many different ways, which undermines the overall growth of the host nation by reducing the productive human capital, leaving more dependents behind, and absorbing limited medical resources as well as affecting the social behavior of the society. According to the ICBL Landmine Monitor Report of 2008, in Afghanistan, 208 people were killed and 601 were injured; in Cambodia, 65 were killed and 287 injured; in Pakistan, 89 were killed and 182 injured; in Lebanon, 37 were killed and 93 injured; and in Iraq, 101 people were killed and 114 people were injured.[79]

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[77] Roberts and Williams, *After the Guns Fall Silent*, 15.

[78] Somasundaram and Renol, "The Psychological Effects of Landmines in Cambodia," 226.

[79] ICBL, "Landmine Monitor Report 2008: List of Release Events," http://www.icbl.org/lm/updates/lm08_release_events (accessed December 9, 2008).

2. Prevent the Utilization of Farmland

Sometimes mines are laid by rebels to obstruct the development activity of a government. Landmines are also laid in vast agricultural lands along riverbanks, dams and irrigation canals. As most mine-affected countries are developing countries, unlike industrialized nations their economies rely heavily on agriculture. Right after cessation of hostilities, farmers look for settlements to support their families by planting and harvesting. The country requires agricultural production to recover.

A presence of mines in farmland therefore hampers agricultural productivity. A few mines are enough to block agricultural activity. Agricultural activity is thus obstructed regardless of the number of mines located throughout the farmland. Farmers will not attempt to harvest as they do not know the whereabouts of the mines and are afraid of death or injury. Therefore, farmers choose not to go to the farmland. Thus, the presence of mines in a country cripples the productivity of agriculture, which is the backbone of the economy.

As more agricultural land becomes unusable for production by the existence of mines, self-sufficient nations become dependent for their food on outside help. According to Kakar, "Without mines, agricultural production could increase 88-200 percent in Afghanistan, 11 percent in Bosnia, 135 percent in Cambodia."[80]

3. Impede the Repatriation of Refugees and Settlement of IDP

During a conflict, civilians flee to a safer place within or outside their countries. They live as refugees in safer neighboring countries and in camps in a reliable region of their own countries as internally displaced people (IDP). With ceasefires and conflict settlement, people want to go back to their homes to resume their lives, and the government seeks to recover from the destruction. The return of refugees and IDP to their home countries and regions is important for individuals as well as for the country. People who were far from home after leaving their properties, family and culture are better off

[80] Gregory L. Bier, "The Economic Impact of Landmines on Developing Countries," Stephens College, Business Department, Columbia, (2003): 656.

back home, particularly if peace is granted. Returnees are also crucial in the post-conflict recovery as human capital for reconstruction. However, in the presence of mines the return of refugees and IDP is extremely dangerous and difficult.

Landmines continue to hurt those who are unaware of their whereabouts and block the return of refugees and IDP otherwise. According to the United Nations and the Human Rights Watch, "after the civil unrest in Mozambique, all 28 major road ways were unusable due to an estimated 1 million mines which have already killed at least 10,000 people."[81] According to Anderson and Palha da Sousa, "the fear of the unknown whereabouts of the hidden killers caused 3.4 million Afghan Refugees (7 percent of Afghan householders) to remain in neighboring Pakistan and Iran in the 1980s. Also approximately 300,000 Angolan, 800,000 Mozambican and 400,000 Somali refugees remain in neighboring countries in Africa."[82] Based on the report of the Ethiopian Ministry of Finance and Economic Development (MOFED), 364,000 people were internally displaced during the 1999 Ethiopia-Eritrea war and were unable to return for a long period of time.[83] According to Green, there were one million Bosnian refugees throughout their neighboring regions.[84]

The inability of such a large number of people to return home makes life miserable and affects their respective country's economy by draining its human power, which was supposed to work in the rebuilding of the war-torn nation. Moreover, the refugees and internally displaced people impose an unimaginable economic burden on their host countries as well as the world. In most cases, it is the United Nations (UN), the International Committee of the Red Cross (ICRC), Save the Children, the United Nations Children's Fund (UNCIEF), the World Food Program, and others which carry the burden of the refugees' subsistence and health.

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[81] Bier, "The Economic Impact of Landmines," 657.

[82] Ibid.

[83] Ethiopia Ministry of Finance and Economic Development, "Ethiopia: Sustainable Development and Poverty Reduction Program," (2002): 35.

[84] Bier, "The Economic Impact of Landmines," 657.

4. Affect the Environment by Destroying the Ecological System

Landmines are found everywhere. They have been laid in forests, swamps, deserts, mountains, grasslands, agricultural land, dams, irrigation canals, riverbanks, residential areas, heritage sites, and many other places. All that matters is what the strategy was when they were laid. However, mostly no one knows the strategies utilized by those who placed the mines. When landmines are laid in forests, they kill wild animals. "Landmines have taken a deadly toll on biodiversity in Africa and other places of the planet."[85]

According to Lt. Col. Martin Rupiya, in Gonarezhou National Park in Zimbabwe, elephants and buffaloes have needed to be killed after they were injured by landmines. In neighboring Mozambique, mines reportedly have killed more than 100 elephants.[86] People also use landmines for poaching protected wildlife. Landmine-poaching has been used against endangered species such as tigers in Burma and other animals in Southeast Asia. "People of the village Mulondo in Southern Angola took mines from mine-belt surrounding their villages and planted them in to the traditional elephant migration path of the Mupa National Park. As elephants flee strictly straight ahead the whole herd was massacred."[87]

As animals continue to be killed, the ecological system is disturbed. Animals, especially endemic ones, are sources of tourist attractions in Africa. If animals of such type are devastated, it is not only the ecology but also the economy which is endangered. Some argue that if there are mines laid in a forest or any place near a forest, humans will not persistently disturb the environment and forests will flourish. However, environmental science is not about removing humans from the landscape, but about repairing damage and creating sustainable use of the environment. Besides, human beings are part of the ecosystem too.

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[85] ICBL, "Environmental Aspects of Landmines," http://www.icbl.org/resources/document/lm_environment.php3 (accessed December 09, 2008).

[86] Ibid.

[87] Ibid.

During landmine clearance, brushes and grasses are destroyed to allow passage and visibility for the clearing asset. The machines that may be used in destroying mines also destroy the trees and topsoil, which results in erosion. Such phenomena have a devastating impact on the environment and the ecological system.

The longer landmines stay in the ground, the more toxic substances leak into the soil. This can be from the chemical composition as well as from the metal or plastic cover decomposition of the landmines. These toxic substances may cause soil disturbances. When crops are planted and harvested such toxins can enter the human body through the food chain. In general, landmines greatly degrade the environment and the ecological system.

5. Are Lethal to Livestock

As landmines are placed everywhere, livestock are also victims. In developing nations, livestock are sources of food and clothing, meat, and wool and hides. They are also used for transportation and agriculture. In some countries like Ethiopia, camels, horses, and donkeys are used as transportation while oxen are used to plough farmland and for food. Livestock are also used as business investments for rural peasants. In some cultures, rural people buy cattle to breed them and later use their milk or meat to sell to make more money. In some other cultures, livestock are considered nothing less than human.

Mostly, livestock are killed by mines while grazing or in transit from one place to another. As minefields are placed where people or animals usually do not go, the grasses and shrubs grow tall and are deceiving and attractive for animals. Herders drive their cattle into minefields unknowingly, with the intention of feeding them with better grasses or shrubs. When livestock are killed this way, farmers are devastated and bankrupted.

According to Neil Andersson, Cesar Palha da Sousa, and Sergio Paredes, "in Afghanistan the bulk of the loss was suffered by the Kuchi (nomads), who reported losses of nearly 35,000 animals; this is an average of 24.4 animals per household, or $2,933 at local market prices."[88]

A survey of 949 villages in Afghanistan documented 264,136 sheep and goats, 55,369 cows and oxen, 36,276 horses and donkeys, and 5,354 camels killed by landmines since the beginning of the war.[89] A survey of 6,090 households in Cambodia reports the loss of 1,284 cows, 139 pigs, 190 oxen, 315 buffalo, and 32 other types of animals for a total of 1,960 animals.[90] As the loss in livestock increases with increased mine accidents, it hurts the farmers and their families as well as the economy of the country.

6. Discourage Potential Investment and Tourism

Landmines discourage potential investment and tourism. When landmines kill endemic animals and block access to cultural heritage sites, tourism is obstructed. When places are abandoned because of the fear of landmines, tourist attractions are no longer maintained. Facilities such as transportation, hotels, and restaurants do not exist. A single accident to a tourist can destroy tourism. A decline in tourism hurts the host nation's economy.

Local and international investors look for potential places to invest. For developing nations, labor-intensive investments are priorities to provide jobs to people. Agro-industries such as food processing, textiles, and tanneries are among the more labor-intensive investments. When livestock are killed, farmlands are blocked and human capital is lost because of landmines, which makes investments almost impossible. Oil and archeological exploration, hiking, sightseeing, and other similar activities are more dangerous to attempt in mine-affected countries unless a guarantee of safety against mines is provided. As most minefields are not marked and people hardly know their

[88] Neil Andersson, Cesar Palha da Sousa, and Sergio Paredes, "Social Cost of Landmines in Four Countries: Afghanistan, Bosnia, Cambodia, and Mozambique," *British Medical Journal*, (2003).

[89] Roberts and Williams, *After the Guns Fall Silent*, 49.

[90] Ibid., 127.

whereabouts, it is unlikely that such explorations or recreational activities will take place. Oil exploration in the eastern part of Ethiopia was hampered by the existence of landmines until the Ethiopian Mine Action Office (EMAO) assigned a team of experts to assist the explorers.[91]

As most mine-affected countries are developing nations, in rebuilding themselves and seeking foreign currency they intend to attract tourists and investors. However, as people from developed nations (or rich people in general) are the potential tourists and investors, they are not willing to risk their lives to visit or invest in a country with landmines. Rich people and landmines do not mix. Therefore, when tourism and investment are hampered by landmines, the economy of the host nation is greatly affected.

7. Prolong or Hinder Reconstruction

A prolonged conflict in a country causes the deterioration of its infrastructure. As the extent of the damage to the infrastructure dictates the country's speed of recovery for its economy, the existence of landmines limits the possibility and speed of reconstruction. Economic development is crucial in an effort to raise income per capita. Economic development is in turn dependent on reconstruction of infrastructure. However, in a war-torn country, infrastructure is damaged badly. Thus, in a country that pursues reconstruction, landmines add to the problem and create obstacles to economic development.

In underdeveloped nations, infrastructure is already limited. There are fewer roads that connect villages to towns and many of those contain mines as they allow military movement. When such roads are unusable and the countries have been in a state of conflict, it can be concluded that the roads have not been maintained for years and hence their condition limits transportation, which reduces trade and productive exchange.

[91] Letter of Request to Ethiopian Mine Action Office (EMAO) by the Minister of Ministry of Energy and PETRONAS Oil Exploring Company, (2007).

As reconstruction of infrastructure promotes long-term development, it also provides massive job opportunities. When such opportunities are denied, people will be impoverished, which ultimately leads to another round of civil unrest and conflicts. Therefore, mines impact the economic well-being of a country by prolonging or prohibiting post-war reconstruction, which is required for sustainable development. In turn, this can lead to more conflict.

8. Deny Access to Infrastructure

There is a high probability of landmines being placed on roads, in residential areas, and around schools, dams, energy supply areas, and water sources, Also, mines are often placed in agricultural and grazing places as well as many other infrastructures. Landmines can be laid to deny access to resources or infrastructures by opposing forces or civilians. After a ceasefire, these landmines become impediments to economic recovery. During war, the transportation network, power lines, water sources, health facilities, schools, and social networks are usually at least partially destroyed. In an attempt to reconstruct these in peace-time, landmines become obstacles. The remaining infrastructures are either insufficient or not accessible due to land mines. In some cases, in order to avoid the landmines, people may have to travel long distances in search of supplies for reconstruction.

When infrastructure is incapacitated by landmines it is difficult to rebuild. It is difficult to utilize the infrastructures for the repatriation. The economic base of the country will be crippled by such a blockage.

> In early 1996 it was difficult to move logistics around the former Yugoslavia due to the significant mine-laying effort made by all three warring parties. According to the Associated Press, former Bosnian warlords have done an enterprising business by helping humanitarian groups move supplies around the extensive network of mines (which they employed). With no safe means of transportation it is difficult for governments, doctors, healthcare workers, teachers, utility repairmen, construction crews, and non-governmental organizations to make their

> reconstruction presence felt in outlying areas of the country. This makes reconstruction difficult, thereby increasing the opportunity for renewed civil unrest.[92]

Therefore, landmines complicate economic development by denying access to infrastructure.

9. Disrupt Market and Trade

People, especially in rural areas, are denied the use of their land because millions of hectares are infested with mines. As rural area land is mostly used for farming and grazing, people will not be able to produce crops and graze their livestock. Basically, crops and livestock are their means of survival, and if denied access to land they are not only unproductive but in danger of starving. Therefore, they will not have products to sell. This phenomenon affects supply and demand which in turn affects the market.

When roads are mined, producers or consumers have to change their routes to go to the market or perhaps rely on subsistence crops. If roads are rerouted, for some the new route will be longer than the previous one, which wastes time and energy. If changing routes is not cost-effective, the result is that some people may decide to quit going to the market. Thus, in the event of a road blockage producers or consumers are not selling or buying, and the transporters are not earning either. Therefore, the markets will be affected drastically.

The more widely landmines are dispersed and the more people they injure, the more they affect investors, tourists and traders, not only by their physical presence but also by the fear they create. Developing nations are the most affected by landmines and a lot of them are in Africa. A landmine threat in Africa causes difficulty in the exploration of resources such as oil and minerals.

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[92] Bier, "The Economic Impact of Landmines," 657-658.

> The United States Assistant Secretary for African Affairs, Susan E. Rice, stated in November of 1999 that Africa supplies over 16% of our imported crude oil. Within the next decade, 20% of our imported crude oil could come from Africa, surpassing the Persian Gulf region. It is no surprise that the USA has a keen interest in the economic development of Africa.[93]

In such cases the presence of mines will definitely reduce market trading.

Cheap labor and raw materials are also available in Africa. However, with a landmine presence, such activity may also be obstructed. In a speech, Condoleezza Rice, the U.S. Secretary of State at the time, said "It is no surprise that the USA has a keen interest in the economic development of Africa. This requires an investment in post-conflict free enterprise and reconstruction that the USA is making."[94] In another speech Rice went on to support the USA's commercial investment in Africa: "from Enron's $2.5B contract to build a steel plant in Mozambique to Southwestern Bell Corporation's $700M stake in South Africa/Telkom. Caterpillar now has dealerships in 15 African countries."[95] In the event of the presence of landmines, such important intervention of investments and markets can be endangered. Therefore, landmines disrupt markets by prohibiting production and interfering with supply and demand, as well as by blocking the utilization and delivery of available resources to the market for exchange.

B. COST IMPACT IMPLICATIONS OF LANDMINES

To identify the cost impact of landmines is not a straightforward process. Various scholars have argued about the measurement of the cost impact of landmines. Their differences were mainly on the assumptions they made and on the data they collected. For instance, Harris and Gildestad vary on the cost impact of landmines on agriculture, human lives, and the impediment to infrastructure. These differences are understandable because academics tend to differ and because the data on which they base their conclusions are quite crude.

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[93] Bier, "The Economic Impact of Landmines," 653.

[94] Ibid.

[95] Ibid.

For the authors' analysis of the cost implication of landmines, this study will refer to the findings of various scholars, but for consistency of comparisons the authors will focus on the Gildestad and Harris survey. However, the authors will also examine the cost approach by Rosen and Gayer.

1. Main Approach and Methodology

The cost impact of landmines can be seen from a socio-economic impact perspective. Due to the enormity of the types of impact of landmines, the authors categorized the types into five major impacts by clustering pieces together.

The five major socio-economic impacts are as follows:

- Deaths or injuries to humans
- Deprivation of farmland
- Death to livestock
- Denied access to tourism
- Denied access to infrastructure

To avoid the comparison of one time cost against one time benefit for the cost-benefits analysis of demining, the productivity lost has been calculated for 20 years discounted to present value rate of 10 percent. A long term productivity increase for example 2 percent for Cambodia is built in to the benefit analysis.

a. Deaths or Injuries to Humans

According to Rosen and Gayer, the value of life can be measured in two ways: lost earnings and probability of death.[96] However, the widely accepted one for Americans is that the value of life varies between $4 million and $10 million. Though it may seem controversial, many argue that the higher people's wealth, the higher their value of life. The reason is that the value of life estimates are taken from data on wages that people insist on being paid to take risks. In other words, the estimates are taken from how people value their own lives. In poorer countries, the wage premiums that people

[96] Rosen and Gayer, *Public Finance*, 165.

insist on for risking death are lower. Thus the value of life, by the people's own estimates, is lower. According to Gildestad's study for Cambodia the value of life is measured by using the lost earnings approach. The value of leisure time is considered, the potential revenue-generating lifetime of adults is deemed to be 35 years, and for children it is considered to be 45 years. The future development of the country is included and the growth of income per person is considered. As a result, the average value of human life (economic loss) comes out to be $259,510.[97] This survey is just for the country of Cambodia.

Other scholars argue that the foregone earnings approach in measuring the value of injuries and premature death is not widely accepted, especially in developed countries. This is because it ignores risk aversion and underestimates the value of life.[98] Developed countries now use the value of statistical life (VSL) to measure premature death. According to VSL the value of life is therefore $240,000 using the willingness to pay format and $260,000 using the willingness to accept format.[99] This survey is based on the country of Thailand.

Based on the estimation of the International Committee of the Red Cross (ICRC) a person with a mine-related injury stays in the hospital for three weeks on average, but an amputee stays for five weeks and requires four operations on average. The amputee needs antibiotics and blood transfusions. In addition, amputees should have prostheses replaced every three to five years for adults and every six months for children. These medical costs have been estimated by Harris to be $550 on an annual basis.[100] This figure is based on the study for Cambodia.

A person injured by a landmine, which includes someone who has had a limb amputated, also has other cost implications in addition to medical costs, i.e., the loss in productivity. According to Gildestad, if death would result in a loss of 100 percent productivity, an amputee would lose 70 percent productivity while an injured person

[97] Bjorn Gildestad, "Cost-Benefit Analysis of Mine Clearance Operations in Cambodia," (2005): 39.

[98] Gibson et al., "The Value of Statistical Life," 513.

[99] Ibid., 518.

[100] Gildestad, "Cost-Benefit Analysis," 37.

could lose 40 percent. In this study of Cambodia the productivity lost in terms of dollars due to amputation (as he/she would not be able to work) was calculated to be $181,657. The lost due to injury was estimated to be $103,804, while the lost due to death over 20 years was calculated to be $259,510.[101]

These numbers can be contested by various scholars. This is because the results depend on various assumptions and approaches that are very difficult to quantify. However, the authors can still use the results to analyze the cost impact of landmines on deaths or injuries to humans.

b. Deprivation of Farmland

Different countries have different staple food items, such as fruit, vegetables, rice, wheat, corn, or luxury crops like flowers, asparagus, brussels sprouts, and strawberries. The value of production, revenue, costs, and specific earnings depends strongly on the type of crop. The productivity varies from country to country and even within the country depending on the climatic condition, type of soil, use of fertilizer, irrigation, etc. General cost estimation is therefore very difficult. However, one can estimate for one country and draw a conclusion about others based on their similarities.

It is important to keep in mind that in underdeveloped countries livestock and poultry are also fed from the remnants of the farmland harvests. According to Gildestad's study on Cambodia, for instance, paddy growing yields one ton of rice per hectare and this estimation lead to revenue of $75,000 per km^2. One pig is assumed to grow and feed from the remnants of one hectare of the farmland harvest and is estimated $54,000 per km^2. Similarly, ten poultry per hectare are estimated $21,000 per km^2.[102] Therefore, the total lost production from a landmine-infested area of 1 km^2 is $150,000. If land is an irrigation farmland, the lost productivity may therefore increase due to the frequent production possibilities.

[101] Gildestad, "Cost-Benefit Analysis," 38.

[102] Ibid., 72.

Gildestad considered the value of agricultural production over twenty years and discounted to present value at a rate of ten percent. A long-term annual productivity increase of two percent is also considered.[103] The authors will take this assumption even though they may need to adjust their conclusion based on their differences.

c. Death to Livestock

The price of livestock differs from country to country and is based on the type of animal. In Gildestad's study in Cambodia, he estimates the value of an animal to be as high as $500, which means $85 per km^2. According to Neil Andersson, Cesar Palha da Sousa, and Sergio Paredes, in Afghanistan the estimated average number of animals per household is 24.4, or $2,933 at local market prices which means $120.21 per animal.[104] The estimated number is based on the number and kind of animals killed at the time the data was available. Thus, the assumption looks very small to the authors, but maybe most animals that were killed were goats and sheep.

For this study and analysis, Gildestad's assumption will be considered, even though in his assumption Gildestad fails to consider the cost implications, for example, for a cow which provides milk at the time it is killed. In addition, Gildestad did not consider the value of oxen that might be engaged in plowing and harvesting, especially in underdeveloped countries. Also, the price of animals such as camels may go beyond $1,000. However, it is a fairly reasonable assumption.

d. Denied Access to Tourism

Visits of historical and cultural sites are crucial generators of income in many countries. They promote economic growth by attracting foreign investment, and generating income for locals in addition to income to the sector itself. The loss of income from mine-affected tourist attraction sites varies from country to country. Some mine-

[103] Gildestad, "Cost-Benefit Analysis," 72.

[104] Andersson et al.,"Social Cost of Landmines."

affected countries could have a high flow of tourists to help their development. The important point here to consider is whether a significant amount of income could have been lost if the sites had not been mined.

Gildestad studied the benefits of opening up a 1 km^2 area of a tourist site from mines and found that it would generate a $1.36 million contribution to the GNP for Cambodia.[105] The main tourist attraction site for Cambodia is in Angkor. This assumption is therefore based on this site. Angkor is the cultural and historical heritage site in Cambodia where the movie *Lara Croft – Tomb Raider* starring Angelina Jolie was filmed. Even as the site is popular, it may give an exaggerated figure; hence, it should be adjusted based on the real income brought in through tourism.

e. Denied Access to Infrastructure

The economic loss from denied access to infrastructure can be seen in terms of road blockage, disruption of water and power supplies, and hindrance to residential property. In an event of road blockages due to landmines, the economic burden is measured by the increased travel time and cost. Road blockage causes travelers to avoid the shortest route to their destination. In the disruption of water supply the burden can be weighed against increased travel time and the cost incurred by fetching water from water wells farther away, and increased waiting time in an event of insufficient supply for the demand. The value of the power supply can be measured in terms of lost production. Similarly, the value of residential property can be measured in terms of the value of residences.

The social losses from landmines can moreover be evaluated in terms of costs incurred for the care of displaced people when the return of displaced people is obstructed. The losses attributable to the increased distance of children attending school as well as the lack of value that could possibly be added from units of education can be considered measures of the obstruction of schooling from landmines. When health

[105] Gildestad, "Cost-Benefit Analysis," 51.

stations are blocked by landmines, there is increased travel for the sick person and those who accompany him/her, and therefore this can be a way to measure the burden of landmines on health issues.

The socio-economic losses from denied access to infrastructures have been quantitatively analyzed by different scholars, but differ greatly due to the range of assumptions they considered. The variations are great but hard to ignore. Assumptions also vary due to the nature of the socio-economic conditions and behaviors of the individual countries. In this project, the authors therefore consider a qualitative measure when they compare the cost-benefit analysis achieved from resolving the hindrances.

C. DEMINING

Demining is defined as

> Activities which lead to the removal of mine and ERW hazards, including technical survey, mapping, clearance, marking, post-clearance documentation, community mine action, liaison and the handover of cleared land. Demining may be carried out by different types of organizations, such as NGOs, commercial companies, national mine action teams or military units. Demining may be emergency-based or developmental.[106]

An ideal response is to remove all risks to human lives and livestock, release land to users, and remove obstacles to sectors such as post-conflict rehabilitation and development.

The increased understanding of the bad effects of landmines, the obligations of countries as the signatories of the Ottawa Treaty and the availability of funds by donor countries have encouraged the development of demining programs designed with humanitarian concerns. Through demining, the economic impacts of landmines can be reduced. Landmine removal means no more landmine incidents, more productive land

[106] UNMAS, "Glossary of Mine Action Terms," 8.

and access to previously denied infrastructures, reconstruction, and investment. Demining is carried out manually by people, with machines, or with dogs and/or with a combination of one or two of these assets.

1. Manual Demining

Manual demining is slow and the most common method used for demining. It is a method that requires the highest precautions and is hampered by dense vegetation, tall and dense grasses, and highly mineralized soil. It is conducted with a deminer holding a metal detector and probe with various accessories moving forward from a safe area in search of any metal signals in a one meter-wide lane marked all the way as he progresses. The deminer wears a helmet, visor, and personal protective equipment to protect him from injuries in case of an accident. All safety precautions are laid out for the evacuation of the deminer in case of an accident.

The deminer continues to detect and probe to find the signaling item while cutting grass and tree brushes with his accessories as they become obstacles to his progress and safety. Any presence of metals triggers the detector to signal and the deminers kneel down to probe and identify the cause of the signal. When a mine is found, it is destroyed in situ. The presence of metal fragmentations causes the detector to signal on and off and the deminer needs to probe again and again. Highly mineralized soils also affect the detector to signal and lead to the same problem. When there is a lot of metal debris it leads to an abandonment of the detection process and dictates the use of continuous probing. Tall grass and tree shrubs cause the deminer to take extra caution and cut them again and again as they appear. When vegetation is dense it may obstruct the operation. It is not uncommon for a deminer to waste time cutting grass and vegetation as well as removing metal fragmentations from the lane before he finds a mine. Thousands of metal fragmentations are collected as a result of false alarms before a single mine is found. At times, there are mines or propelled UXOs immersed deep in the soil that are not able to be detected.

The manual demining process is tiring and tedious work, especially when the weather is hot or cold. The standing and kneeling, the cutting of grass and shrubs, and the

unhappiness from collecting metals as a result of false alarms coupled with extreme weather affects the focus of the deminer and ultimately may lead to accidents. Other personal technical mistakes also lead to accidents. Moreover, the presence of mines with low metal contents makes it difficult for detection by metal detectors. This causes a deminer to step on a mine and in the best case scenario only be injured. Therefore, manual demining is not only slow but also dangerous.

2. Dog Detection

Dog detection is reasonably faster but limited by weather conditions, vegetation, topography, and high concentrations of TNT in the soil. In this method of demining, a mine detection dog (MDD) is trained to react in a procedural way to the smell of the explosive or TNT emitted to the soil from the inside of the mine. A MDD is handled by a person and when the MDD finds a mine it communicates with its handler. To discover the suspected item by the dog, a deminer has to go and probe to uncover the item. If the item is a mine then it is destroyed by the deminer. MDDs have to keep their heads down at all times to smell properly, but when grass is tall and when the weather is hot, they have a hard time doing so. A well-trained MDD is important in demining because it can eliminate the time that could have been wasted uncovering false alarms of debris and metal fragments by deminers. A MDD is a preferred method to clear railroads where metal detectors are difficult to employ.

MDDs have a hard time working uphill as it is difficult for them to keep their heads down. Their attention is easily diverted and they get tired quickly. Depending on the weather, their working hours can go as low as two hours and usually do not exceed five hours. Their training is complicated and expensive as well. They are most productive if used in conjunction with other assets.

3. Machines

Machines are designed in various forms to destroy mines. They are designed so that they punch the mines in the grounds while flailing using the attached weighted chains and hammers hung from a revolving drum in an armored motorized vehicle. The

flail system can be replaced by rollers, tillers, excavators and ploughs, depending on the usage. The system is similar but adapted to the nature of the threat and the ground the mine resides in. Some can be remotely controlled or operated from a cabin. When a machine is operated remotely, there will be a greater chance of missing mines as full visibility of every spot is impossible. Even when closely operated from a cabin, there can be irregular land which makes it difficult to punch a mine that has been laid on a hole or on a side of rock. Some mines may also resist sudden impacts generated by the flail.

Machines are valid if used in dense vegetations, tall grass, and hard soils. They cut vegetation and grass and break hard soils to make it easy for dogs and deminers to operate. Excavation-type machines are also used in clearing mine-suspected, destroyed buildings. Machines cannot be used on rocks, hills, or in swamps. It is also unwise to use them in an identified AT minefield area. Machines are probably the fastest method of all demining methods but they are not considered as a standalone clearing tool based on international humanitarian standards. They must be accompanied by either dogs or manual methods to certify their work. This is because machines do not punch every mine in the ground and may leave mines untouched or not fully destroyed.

4. Combined Assets

The use of combined assets is important in maximizing the effect of demining. The weakness of one asset can be offset by integrating another asset with it. MDDs are good at reducing the size of the fields to be detected. Machines can cut the grass and shrubs that consume much of the time of a deminer or make it impossible for dogs to operate. Each one is not a replacement for the other but a support to each other. Therefore, the different assets of demining should be treated as a toolbox where all tools are used when needed in their proper function. With such an approach demining becomes advantageous and less costly. Such approaches need serious and continuous planning and prudent coordination.

Demining is a slow and dangerous process. This behavior makes demining an expensive business. Therefore, its management is difficult due to changes in operational behavior with the situations on the ground to be demined. As things frequently change,

plans should be developed actively to fit the circumstances, and proper asset employment is required. The main difficulty of demining is to manage the operation and its demand for cost minimization as well as its requirement for development in order to maximize its benefit. Demining cannot be seen as a standalone project. If hundreds of hectares of land are to be cleared of mines because it only kills or injures five to ten people every year, then its benefit may not be maximized. However, if such land is cleared because it kills, blocks access to infrastructures such as road, water wells and residential properties, then the costs can be justified.

According to Bier:

> Country-driven, results-oriented demining programs must be integrated with basic social and economic development for effective and sustainable post-conflict reconstruction. Viable infrastructures are necessary in all aspects of a micro and macro-economic reconstruction effort. Failure to re-establish the infrastructure dimension of the economic environment will prolong economic misery, dampen any international trade and market opportunities and simply fuel tensions and return to conflict.[107]

The expense of demining should be compared to the cost. Generally, demining is a slow and labor-intensive task that consumes high amounts of resources that could be used for something else. Demining is slow because the operation is so dangerous and it has to be dealt with cautiously.

When demining becomes slow, its goal of alleviating the impact of landmines can also be delayed. In the case of the support of emergency recovery and urgent humanitarian needs, demining can be frustrating. To overcome such slowness, a better planning approach and the employment of the best demining methods is crucial. If the ultimate goal is to protect people from entering the mine field so that they are not injured, then clearing the mine field may not be the best option. They may choose to educate the people, prohibit them from entering by employing guards, post signs, and use other relevant methods. If the ultimate goal is to support the reconstruction of a devastated town by clearing the road for contractors to deploy their machinery, then it should be planned accordingly. Human lives will also be saved in the process. Thus, demining

[107] Bier, "The Economic Impact of Landmines," 661.

should be planned as to link to the ultimate goal of costs and benefits in mind. There should not be demining simply because there are mines. There should be prioritization based on a maximizing benefit. Unless politically driven or implied cost justifications exist, farmland is usually not chosen for demining over an existing oil field. The idea is land should be cleared if it is going to provide a measurable benefit.

If the option to demine is chosen, it is important also to choose the right approach. Unless a minefield has sketches and proper marks of the whereabouts of the mines, it is difficult to pinpoint them in a given plot of land. In such a case, the responsible body must choose the preferred approach to demining. Because deminers do not know where to start, they often spend more time and resources to get to the actual mines. To protect such waste, a proper land survey and area reduction approaches should be chosen first. Before deploying the units to demine, they should know where to start and what method of demining to use. If it is steep, hilly ground, should they use dogs, machines, manual methods, or all of them combined? What methods should be used that are important in facilitating the job and reducing cost? By choosing the best assets and marrying them properly, the best return on investment is achieved and the facilitation of the demining process helps the ultimate goal of time.

For example, an anti-tank minefield is costly to demine with machines. However, in dense vegetation and on flat ground, machines are good tools to employ, followed by dogs, but to demine such dense vegetation manually would be costly. "The generally accepted cost of mine clearance for Cambodia in average is $6,500-$7,000 per hectare ranging from $6,500 for Cambodia Mine Action Center (CMAC) to $13,500 for other NGOs. The figure falls to $4,000 with the use of mine detection dogs."[108] Employing the best-suited assets with better planning and implementation will make demining less costly. According to Gildestad's findings, mine clearance in Cambodia falls between $0.90 per m^2 and $0.70 per m^2 (when efficiency of clearance increases).[109]

[108] Geoff Harris, "The Economics of Landmine Clearance: Case Study of Cambodia," *Journal of International Development*, (2000): 221.

[109] Gildestad, "Cost-Benefit Analysis," 54.

A contributing factor to the slowness and increased costs of demining is the standard of clearance. Most mines are found in developing nations and the main donors of demining activities are developed nations. Since the value of life is high in most donor countries, the standards of demining are made to fit the standard of living of the developed nations. Thus, demining standards are very high and able to protect deminers at work as well as end users of the land after the land is cleared. Based on such standards, every meter of ground must be investigated for any possible missed mine. Such standards demand 100 percent of clearance, which prohibits the employment of machines that make demining faster. However, in the economic approach of developing nations such standards are too high in relation to the cost. In developing countries such as Africa, there is a huge problem of malaria, but to eradicate malaria you do not hunt every mosquito.

The donations for demining are sometimes linked to humanitarian and political issues. Once landmines are declared lethal and indiscriminate by the advocacy of influential NGOs and aid workers, they remain highly noticed as a humanitarian issue. Many projects that can sustain development in developing nations are priorities to the nation, but are not financed like demining projects are. In most cases it is the economic growth that can resolve humanitarian problems in developing nations. Mine-affected nations receive funding for demining from donor countries. If they wanted to switch that money to other programs, that would not be possible. If they declare that they do not need demining funding but need other programs, donors might not be willing to give what could have been funded for demining. As there is no incentive to declare an early finish when it comes to demining, requirements for demining funding will be everlasting. The donors are aware of this. The problem is that the donation itself often fulfills the donors' political commitments.

NGOs, commercial companies, UN, and government organizations are involved in the demining industry. Even though most demining activities are carried out through donations, some are paid for by companies for the clearance of the land. When companies pay for the demining of their land, it becomes evident that the benefit of demining is high. However, in the event of a donation to NGOs, commercial companies and governmental organizations for demining, it is apparent that demining organizations

exaggerate the presence and impact of landmines to convince donors and receive more funds. Since the end users do not have power when it comes to the funds and benefits, they have no say. In fact, they may choose to agree with the demining organizations, so that their land is again and again checked for mines.

D. THE OBJECTIVE OF DEMINING

1. Humanitarian

"Humanitarian demining, a core component of mine action, covers the range of activities which lead to the removal of mine and unexploded ordnance hazards. These include technical survey, mapping, clearance, marking, post-clearance documentation, community mine action liaison and the handover of cleared land."[110] In general, humanitarian demining is regarded as a short-run emergency mine clearance of land with 100 percent efficiency.

Humanitarian demining differs from military mine clearance mainly in its purpose. The purpose of humanitarian demining is to clear a land from mines and other explosive remnants to return to the end users, whereas military mine clearance is intended to open a passage for troops. Therefore, the military may breach a path through a minefield without destroying every single mine in the path. However, demining for humanitarian purposes requires 100 percent clearance of the land from mines; otherwise it is not deemed as safe land.

Demining for humanitarian purposes is slow due to its 100 percent clearance requirement, and it is dangerous because a simple mistake can cost the lives of the operators. Humanitarian demining programs are often aimed at quickly safeguarding people living with the threat of landmines. Peacekeeping forces need safe movement to carry out their activities. Additionally, food, medicine, temporary shelter, or some emergency materials may need to be delivered to those who need it. When such activities are obstructed by the presence of landmines, a humanitarian demining is imperative. This

[110] GICHD, *A Guide to Mine Action*, 63.

demining activity can be limited to opening access roads, clearing residential areas, creating temporary relocation places, and the like. Demining to allow such emergency assistance can be acceptable; however, it should only be for a short period of time. If it goes beyond a short period of time or demining is no longer for emergency purposes, then there must be a justification for its value. When demining for such purposes exceeds the emergency need, it is difficult to defend its cost especially in countries where they have other humanitarian needs. Therefore, demining for humanitarian purposes should not last a very long time. Otherwise, demining for humanitarian purposes will not justify the cost.

In an emergency situation the cost of demining can be defended. For example, when people need to return home and if access is not provided, people will either die or be restrained from returning. When many people die demining can be justified because the benefit from demining can be proven against the cost of many people's lives. Moreover, when people are restrained from returning they need to be supplied with all their needs. To supply human needs forever is very costly, and thus demining for the return of displaced people is beneficial. In the absence of access to roads due to mines to a community who needs emergency aid, demining again justifies its cost because aid will have to be delivered by other means such as helicopters or planes, which is more expensive than road transportation.

However, when road access is provided through demining and people are returned back to their homes, they will still need to build their daily lives. This can be through using their farmlands, breeding cattle, using water wells, developing a power supply, going to school, and rebuilding their residential areas or any other daily activities. In such situations, the cost of demining needs to be calculated in comparison to its benefits. The decision makers should show that demining activities to provide such access to the community have a benefit greater than the associated cost. Every plan of the demining activity should be linked to promotion of the development of the community. If demining is not linked to development it will be difficult to justify it for only humanitarian purposes. The prioritization of demining in terms of the outcome of the land to be cleared should be calculated against the cost and set in place before any demining activity. If one

cannot do this, resources will be wasted because the short-run humanitarian need will change to a development requirement and it will be hard to justify the cost in relation to the benefits. Therefore, after emergency needs are resolved, the next steps for demining should be conducted based on a cost-benefit analysis.

2. Economic Development

Demining for economic development is in essence similar to humanitarian demining, and their difference is the thoughts in mind during planning and prioritization. The authors regard demining for economic development as a long-run economic development promotion gained from the mine clearance of land with 100 percent efficiency. The achievements of such development are in the long run through its tangible and intangible benefits. What this means is demining operations should be carried out with long-term developmental goals in mind and not short-term emergency achievements.

In previous chapters the authors discussed the cost implications of landmines and their effect on human lives and economic development. Thus, the effects must be eliminated in a cost-effective way. The best way to justify the cost effectiveness of demining is to link it to economic development. If mines are left behind, they surely will injure or kill someone sooner or later. The fear of this leaves most stranded and that is how it affects economic development. However, should we then remove every mine? Resources are too scarce to waste them by hunting mines. Besides, the number of mines does not dictate the amount of economic development obstructed. A single mine and five or ten mines may have the same negative effect. The former may also deny more access than the latter as long as people are not informed of the mines' whereabouts. For example, a road with one or two mines and a road with ten or twenty mines will be abandoned by the users as long as no one knows the exact location. To remove the threat is also equally problematic as long as the experts do not know the boundary of the threat. What makes landmines significant therefore is their location.

In 2002, 450 kilometers (280 miles) of railway were cleared of landmines to open the way for rehabilitation in Mozambique. After the clearance of the railroad, the benefit

from demining was at least $2.25 million. This benefit estimate was from foreign investors and it was so high because of the increased export of coal, diamonds, copper, and graphite that it led to.[111]

A landmine placed in farmland that can grow corn and a landmine laid in an oil field, road, or tourist site will not have the same impact on economic development. The former may have less impact in economic development to the country compared to the latter. Thus, priority for the removal of the threat should be given to the latter one. It can be argued that a landmine that threatens a recreational area is less important than a landmine that threatens an agricultural area that feeds hundreds of people. However, the income that is collected from the fee of the recreation area may be far greater than the income of the farmland. That is why the one that promotes economic development should dictate the priority of demining. In such a way one can maximize the return from demining.

In a war-torn nation the return of displaced people may become a top priority. The act of demining with that and only that in mind will make demining less beneficial than otherwise. However, if the planners of demining consider what will happen after the return of the displaced people and also consider developmental objectives such as the provision of access to infrastructures to the returnee, they will increase the benefits of demining.

Also, mine-affected countries have demining organizations organized in one center, and of course other developmental organizations have their own demining department or ministry. The demining organizations receive their priority of work from the government based on a set of standards. The developmental organizations also have their plans. If these plans are not coordinated at a high level and the implementations are not executed based on the coordination, they are not as likely to be successful. For example, before any action take place, road construction or maintenance needs to be coordinated with the demining organization for information about possible landmine

[111] Journal of Mine Action Web site, http://maic.jmu.edu/JOURNAL/9.2/feature/lundberg/lundberg.htm (accessed April 22, 2009).

problems. If construction is awarded to contractors and landmines are found in the area while constructing, the need for demining will be inevitable. This will impose a high cost and delay on the construction.

When a mine is laid on a railroad or any other road, it will surely deny access to its use, hamper trade and market, and add cost as a result of long-distance travel. The removal of this threat will promote trade and market, shorten the long-distance travels, and connect the societies at both ends. To put such benefits in terms of dollar value may not be easy. One cannot claim that all the benefits that would be gained are from demining of the road, but it is obvious that demining would play a key role and if demining did not occur, such benefits would not be gained. Other benefits such as promoting developmental goals, reducing poverty, improving quality of life, etc. are not easy to gauge and measure tangibly in a short period of time, but they can be measured intangibly and in the long term.

Actually, demining that supports post-conflict rehabilitation, reconstruction, tourism, irrigation, access to infrastructure, and other similar activities is more likely to pay back in terms of benefits. The main existing controversy among researchers and scholars is not the recognition of the impact of landmines, but the cost-effectiveness of removing them with the current capabilities. The cost-effectiveness of removing mines is widely accepted and justified when demining is conducted for economic advancements. Some argue that landmines should not be cleared because they simply kill or maim people or livestock. Their justification is based on the measure of the cost of human lives in terms of forgone earnings compared to the cost of demining, and they calculate the cost of demining to be higher. Others argue that the impact of landmines cannot be limited to only a threat to lives, and even with that not factored in, the removal of mines is less costly than the value of human lives.

E. THE COST-BENEFIT ANALYSIS OF DEMINING

In order to justify that demining is worthwhile, a comparison of costs and benefits is vital. Many scholars and experts argue about whether demining is worthwhile. Some

say demining is not worthwhile and other alternatives must be sought out,[112] and others argue that demining is worthwhile if carefully planned and tied to economic development.[113]

Different studies have been conducted to identify the cost of clearance per unit of measure and most of them vary. The cost differences in these studies arise for various reasons; the major ones come from the nature of the land cleared and the employment of assets for the demining. Organizations engaged in demining that employ and coordinate the right type of assets are likely to demine more cheaply than their counterparts that do not. Similarly, organizations that are engaged in a convenient environment and ideal ground are likely to achieve greater productivity than others that are not. The collection and analysis of data can also lead to findings of additional cost variations.

For example, a study in Cambodia by the Cambodian Mine Action Center reveals an average cost of $0.95 to clear a square meter ($1m^2$) of land.[114] In the same country, based on the calculations by a British NGO, the HALO Trust, the cost is $0.68 per m^2.[115] According to the estimate of the Landmine Monitor Report in 2003 the cost is calculated as $90 per hectare ($0.009 per m^2) in one area of Cambodia, while in another place, the cost varies between $100 and $250 per hectare.[116] This particular cost looks unrealistic and it was revealed that the organizations that produced the estimates used unprofessional personnel for the job. Their lack of experience may have led to the accidents. A recent study conducted by Griffin and Keeley shows that the cost of landmine clearance per m^2 is $1.50 when only manual demining is used and $0.96 per m^2 with the mix of machines, mine-detecting dogs, and manual demining.[117]

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[112] Harris, "The Economics of Landmine Clearance," 224.

[113] Gildestad, "Cost-Benefit Analysis," 68.

[114] Ibid., 54.

[115] Ibid.

[116] Gildestad, "Cost-Benefit Analysis."

[117] Ibid.

In a study of the same country but for earlier years, Harris finds that the cost of clearance per m^2 of land falls between $0.65 and $0.70.[118] This study is closer to the calculation used by the HALO Trust. It is now clear that the cost of clearance differs even within the same country. The variations are again due to various factors that influence clearance rates. For the comparison in this project, the authors will use the rate of clearance in Cambodia that falls between $0.90 per m^2 and $0.70 per m^2 (when efficiency of clearance increases). The authors think this is reasonable because the assumptions used to reach the result makes sense. Moreover, the study is recent and based on better data, and it does not deviate much from the other surveys.

In the authors' cost implication of landmines study, their assumptions are based on Gildestad's study of Cambodia. Therefore, to compare the cost implication of landmines with the benefits of demining, they prefer to stay in the same study for consistency.

The comparison of the benefits gained from demining to the cost impact of landmines on human lives saved is measured in terms of reduced human losses. The assumption of Gildestad is that 1 km^2 of land would kill or injure one person every year for 20 years. This implies an average economic loss of $164,000 for Cambodia. To clear 1 km^2 of land costs $900,000 (based on $0.90 per m^2 terms). In most cases, AP mines are laid one meter apart from each other. 1 km^2 of land can employ hundreds of thousands of mines. These hundreds of thousands of mines will definitely claim more victims every year as it has been clearly observed in most surveys and reported by the ICRC, Landmine Monitor and Handicap International. Therefore, in an event of six or more accidents per km^2 of land, the benefit of demining outweighs the cost. Moreover, the benefit of clearance of 1 km^2 of land is not limited to only gains from reduced human losses. The land can be used for agriculture, residential property or something else, which adds more value to the benefit of demining.

Of course, the main existing controversy among researchers and scholars is not the recognition of the impact of landmines but the cost of removing them with the current

[118] Harris, "The Economics of Landmine Clearance," 221.

capabilities. Some argue the fact that landmines kill or maim people or livestock is not a good enough justification for clearing them. The justification they use is that the cost of human lives, measured in terms of forgone earnings (present value of lost earnings), is much less than the cost of removing them. Others argue that landmines threaten not only lives but also other things. Even if that is so, the removal of landmines is less costly than the value of human lives especially when the numbers of accidents are higher. Their reason is that the measure of foregone earnings in developing countries is not acceptable because it ignores the risk aversion and underestimates the value of life.[119] Instead, developed countries now use estimates of the value of statistical life, which is calculated by one of the approaches below.[120]

- From reports by survey respondents of how much they would be willing to pay to avoid risks (or how much they would need to be paid to accept risk)
- From market-based revealed preference studies

Therefore, the value of statistical life (VSL) calculation may show that the benefits of demining, due to lives saved, exceed the cost of demining. In the authors' view, it is difficult to measure the value of life of a human being because people value their lives differently. However, in either way the impact of landmines is not limited to only threats to human lives. Wherever they exist, landmines occupy land and block access to the use of the land in addition to threatening lives. Therefore, landmines should be removed to the extent that the cleared land provides benefit greater than cost, and should be prioritized in relation to other similar goals. For example, if the demining of a certain field will save 100 lives in 10 years and the same amount of money could save 200 people in traffic accidents, one may decide to spend the money in traffic accident alleviation. However, it is important to remember that demining saves land so that it can be used in the future, whereas with preventing traffic accidents such value may not be achieved. Hence, choices should be made to maximize the benefit for a given cost.

When considering the cost implications of landmines on farmland, recall that costs were measured in terms of the value of the crops grown, the animals such as pigs

[119] Gibson et al., "The Value of Statistical Life," 513.

[120] Ibid.

and poultry which could have been fed from the residue of farmland, and the value of the land itself. The total sum of lost production from a landmine- infested farmland of 1 km^2 in size is $150,000. This benefit is less than the cost, which is $900,000 per km^2.

However, when farmland produces luxury crops or plants such as flowers, asparagus, brussels sprouts and strawberries, the value of lost productivity will increase. When farmland is irrigated so that it produces two or three harvests annually, the benefit of demining may outweigh the cost, or when demining is performed efficiently, based on the authors' assumption, the cost of demining becomes less. Thus, the act of demining may become worthwhile. Moreover, farmland can have unforeseen benefits or can be used in conjunction with other benefits, which consequently adds to its value. A good example is when a mine-related accident occurs on potentially valuable farmland. In such a situation, demining such farmland can be beneficial because it can prevent future mine-related accidents and as a result of demining, the farmland will produce more value.

On the other hand, when the value of the farmland is less, the price of the staple crop item produced is lower and fewer (or no) animals are using the residue of the farmland, the value of lost productivity becomes less, and it is not worthwhile to clear the farmland. Therefore, a careful analysis of the benefit of the demining of farmland is crucial before any action takes place. Such analysis can be conducted by collecting the right information on the production capacity of the farmland and its future uses from local communities. The bottom line is that demining a farmland is not worthwhile unless there are unique circumstances.

The decision about which place to demine and which not to demine is a very complicated decision. Whether demining farmland is worth more than it costs depends on the particular circumstances. Unfortunately, demining organizations or central planners are rarely able to know the relevant circumstances. There are two sources of uncertainty: uncertainty on the cost side and uncertainty on the benefit side. If, for example, a particular piece of farmland were de-mined, it would become more productive. However, the owner of the land might know the specific parts that need to be de-mined, thus lowering the demining cost. Also, he might have in mind a particular crop that he can grow on this subset of land and, therefore, have a good idea of the demining benefits.

Both of these pieces of information, on the cost side and on the benefit side, might not be available to demining organizations or central planners.

This problem is similar—indeed, it is the same—as the problem of central planning that Nobel laureate economist Friedrich Hayek addresses in a series of articles in the 1930s and 1940s. Hayek points out that, even aside from issues of incentives, central planning fails because central planners, no matter how brilliant and how informed, simply cannot have the local knowledge—what Hayek called "knowledge of the particular circumstances of time and place" that individuals have.[121]

Therefore, conscious planning and prioritization, as well as selecting the right approach to demining for cost-effectiveness based on the right information of the locals, are needed. For example, Mozambique has a population of 17.6 million. It is estimated that 64 percent of the population live off subsistence agriculture and that two-thirds of the population lives in absolute poverty.[122] In circumstances like this, even if demining is not cost-effective it may be necessary for survival reasons until other long-term options are identified. On the other hand, this information can also be refined more by working with the local communities, thereby contributing to the cost-effectiveness of demining.

In comparing the value of livestock to the cost of demining, the benefits are less than the costs. In the Cambodian survey, Gildestad estimates that the value of an animal is as high as $500, which means $85 per km^2. Even if the value of an animal is estimated to be twice what Gildestad assumed (because a milking cow can also be killed) and compared to the cost of demining per km^2, there is no reasonable gain from demining a grazing land unless all or an unimaginable number of animals are killed annually. Therefore, saving livestock is not a sufficient condition to warrant demining as the benefit is much less than the cost.

Gildestad studied the benefits from opening up a 1 km^2 area of a tourist site from mines and found that it generates for Cambodia a $1.36 million contribution to the

[121] Hayek, Friedrich A., "The Use of Knowledge in Society," Library of Economics and Liberty, http://www.econlib.org/library/Essays/hykKnw1.html (accessed May 09, 2009).

[122] Merrouche, "Landmines and Poverty," 3.

GNP.[123] On the other hand, the cost to demine per km^2 of land in Cambodia requires between $0.90 and $0.70 per m^2. In this situation, to clear a historical and cultural site that is a tourist attraction is a sufficient reason for demining. Moreover, one tourist killed or injured means a disaster and it is costly to reverse the reputation of the site as tourists will be scared and unwilling to compromise their safety. Besides, income from tourists has another important value, which is the provision of hard currency to the country.[124] Therefore, the benefits gained from demining a tourist site is great and outweighs the costs.

If roads are blocked due to landmines, the economic burden is measured by the increased travel time and cost. In his study of Cambodia, Gildestad calculates that the demining of a blocked road is beneficial and outweighs its cost.[125] His study did not even consider how market trading is hampered by a road blockage. For example, railroads are mostly known for bringing societies closer to each other and promoting market trading. He also did not consider the event of no other road options. However, considering his assumption and highlighting what he did not account for in his calculations, the authors concur that the clearance of landmines on blocked roads has benefits.

When a government and society are detached due to blocked roads and when aids are hampered due to the same reason, the demining of roads becomes not only beneficial but also urgent and mandatory. This situation is common practice in recent peace-agreeing forces of mine-affected countries, where the peacekeeping endeavor, supply of aid, and health assistance are hampered. For example, "The discovery of landmines along three distribution routes used for aid deliveries to the Angolan provinces of Malanje, Cuando Cubango and Huambo has caused the World Food Program (WFP) to halt food aid for 40,000 people. WFP spokesman Marcelo Spina said: there are many other areas that we cannot even access because of landmines."[126] Such requirements dictate

[123] Gildestad, "Cost-Benefit Analysis," 77.

[124] The reason hard currency is worth more than it appears to be worth is that various governments have exchange controls that undervalue foreign currency.

[125] Gildestad, "Cost-Benefit Analysis," 74.

[126] United Nations Foundation Web site, http://www.unwire.org/unwire/20030103/31200_story.asp (accessed April 14, 2009).

demining not only due to economic benefits, but due to emergency needs. This shows that demining of a road benefits more than the cost. However, it is important to note that every road does not provide the necessary benefit. Thus, local information must be collected and used for the planning of demining before any action takes place.

When there is a disruption of the water supply, the burden can be weighed against increased travel time and cost caused by fetching water from far away water wells, and increased waiting time in an event of insufficient supply for the demand. Likewise, Gildestad's study of Cambodia reveals that the benefits gained from the demining of a water supply justify its cost[127]. However, he assumed only fifteen beneficiaries. This figure is by far less than the situation of most mine-affected countries where hundreds of people rely on water from a single water well. For example, In Malawi, six completed community shallow wells are providing water for 750 people with 125 users per water point.[128] In addition, consider what would happen to the health of the people when they could not use the rarely existing sanitized water due to these landmines. The cost of health problems brought on due to the use of unhealthy waters adds up to the cost of expenses caused by the impact of landmines to boost the benefit of demining. In a situation like this, the benefit from demining of water wells, therefore, is substantially higher than its cost.

The value of the power supply can be measured in terms of decreased production. During the Ethio-Eritrea war, the power supply of some northern Ethiopia towns, in particular Zalanbesa, was completely cut off. Right after the cessation of hostilities, the maintenance of the power supply lines was hampered due to mines. Sixteen thousand people were without the power of light. In such a situation, clearing the power supply lines to provide the power of light to the dwellers is not only economical, but it is also a must due to its political and social repercussions. Another similar example is in Mozambique where the impossibility of repairing mined electrical lines reduced its output and increased the country's imports of electricity from $1 million in 1980 to

[127] Gildestad, "Cost-Benefit Analysis," 48.

[128] Peer Water Exchange Web site, http://peerwater.org/projects/46-Chikwawa-Water-and-Sanitation-Project (accessed April 14, 2009).

$10 million in 1988.[129] In May 2003, landmine clearance was conducted in Iraq in support of the Iraqi Electrical Office to provide power to downtown Baghdad. This clearance of landmines promoted a 50 percent increase of power flow to the downtown area where people needed electricity desperately.[130]

Similarly, the value of residential property can be measured in terms of the value of residences. Mines laid in a residential area cause frequent accidents due to their location near people. People that can be killed as a result of mines laid in residential areas can aggravate the need for demining even when calculated in economical terms. The value of residential areas is at least higher than agricultural areas. Also, when people are displaced from residential areas infested by mines, their repatriation demands the removal of the mines or the building of new homes somewhere else. When the risk of accidents posed by landmines is added to the value of the property, it becomes fairly obvious that the benefit exceeds the cost.

The socio-economic losses from landmines can be measured in terms of costs for the care of displaced people when the return of displaced people is obstructed, and the value lost due to additional travel distances and time needed to travel to a health station. The value of the lost education or the increased distance of going to school can be considered a measure to the obstruction of school from landmines. When health stations are blocked by landmines, there is an increased travel of the sick person and those who accompany him/her, and, therefore, measuring this can be a way to measure the burden of landmines on health issues. Moreover, despite the difficulty of quantifying, the social problem posed by landmines can also be measured by the impact it causes on the obstruction of millennium development goals, poverty reduction, and the attempt of government building capacity to meet Ottawa Treaty obligations.

The social disturbance caused by the injury or death of a head of household with a couple of kids left behind can be measured in terms of the burdens to the society to take

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[129] M. Litzelman, "Cost Effectiveness and Cost-Benefits of the Ethiopian and Eritrean Demining Programs," (PhD dissertation, George Mason University, 2001), 169.

[130] Journal of Mine Action Web site, http://maic.jmu.edu/JOURNAL/9.2/feature/lundberg/lundberg.htm (accessed April 22, 2009).

care of the kids; the injured ones drift to towns and become beggars. Consequently, they affect the security, traffic, and sanitary conditions of the cities. When married women are injured, usually they are deserted by their husbands. If they are not married they will not get someone to marry them. This is also another social disturbance in a community. The presence of landmines also causes fear and trauma, especially to these who have seen and experienced the accidents. The effect it has on the destruction of ecological systems and environment through killing of wildlife can also be measured. Therefore, though most benefits of demining are difficult to quantify, demining activities conducted to promote a socio-economic benefit are worth considering.

The effects of landmines are enormous and can be assessed in different ways in terms of the economic approach. Their impact can be viewed as direct or indirect, national or global, humanitarian or economic. The fact of the matter is landmines are hidden killers and obstruct overall economic development of developing nations that emerge from conflict to peace and hope for growth, as well as the well-being of their people. Landmines affect in different ways such as killing or maiming productive human capital, preventing the utilization of farmland and obstructing production, impeding the repatriation of refugees and settlement of IDP, disturbing the environment by destroying the ecological system, killing or migrating livestock and wildlife thereby hindering animal products, prohibiting potential investment and tourism and denying income and access to hard currency, prolonging or hindering reconstruction thereby darkening future hopes for development, and denying access to infrastructure and disrupting market and trade. Moreover, mines are often taken out of mine belts and used for terrorist acts elsewhere.

As landmines challenge the economic growth and survivability of human beings, their use need to be challenged. As the authors have shown above with a cost-benefit analysis, leaving landmines in place when they threaten economical and humanitarian goals is not generally a good idea. In pursing economic development and laying out economic goals in developing nations, the issue of landmines should not be seen separately and needs the highest consideration when addressing them. The act of demining in relation to the cost posed by landmines requires serious planning and a cost-

benefit analysis. When the benefits exceed the costs, demining is imperative. Some say it is imperative because the saving of a human being does not have to be justified only by cost. They believe everyone has a moral obligation to save lives. The alleviation of such human suffering is a humanitarian act.

In this study, the demining of land must be justified against cost in the long run, because the authors believe people continue to suffer via other means if not by landmines (i.e., malaria, a traffic accident or HIV/AIDS), and resources are scarce to address everything. Humanitarian imperatives will continue to emerge in various forms, but if not prioritized carefully the impact of scarce resources will be minimal. Saving human lives should not be the only reasons to drive people to demine, particularly when the accidents are few in number. For demining to be justified, benefits should exceed costs and these benefits can include human lives saved and other benefits.

The number of accidents can be confusing for cost-effective planning of demining. Sometimes, few incidents can kill many people. For instance, when a bus is blown up by a single landmine while many people are on board, all may be killed or injured. Consequently, the number of victims may be high. During the planning of demining this kind of incident should not be confused with the accidents happening to people in their daily activities. The reason is that the bus incident does not represent the overall picture of how landmines affect a particular country. Another example is when one Western journalist or tourist is killed or injured in another mine-affected country. The danger of mines and minefields becomes so clear to the donor countries and funds start to flow, and as a result actions prevail. Such emotions should not influence demining planning to justify its cost-effectiveness. Unfortunately, this happens a lot.

It is fairly simple to understand the benefits gained by demining oil or gold fields. However, the clearance of agricultural land alone is in most cases difficult and it needs to be coupled with other values. For instance, agricultural land can be located in power line sites or near water wells. Mines can be placed where a lot of people and animals live nearby and thereby threatens their lives. Other economic-rendering sites such as cultural and historic heritages are important to demine.

There are many ways demining can be beneficial in comparison to its cost. Some may seem very difficult to justify quantitatively due to the fact that the benefits are linked with so many other factors, but qualitatively it is possible. The demining function in promoting the millennium development goals (MDG) and poverty reduction allows access to resources and infrastructures. Access to education and health are important not be denied for the well-being and development of a country's economy. A country should be able to use its available resources such as water and power supplies. It should have access to infrastructures such as roads. However, it should be noted that the type of road, power supply, water well, or school that is most worth accessing will vary from case to case. Therefore, prioritization and careful analysis and planning are imperative before the act of demining.

While demining is important when justified by cost/benefit analysis, a strategic approach to the over all halt of the use of mines is important. That is why many countries are joining the Ottawa Treaty and conforming to its obligations. It's fine to remove landmines, but if they are going to be laid again, what's the point? "The United Nations estimates that, in 1993, approximately 2 million new landmines were laid. During that same period only 100,000 landmines were lifted."[131] If a mechanism is devised on prohibiting the use of landmines followed by controlling and monitoring them, removing landmines can be one option. Fencing and temporarily or permanently marking landmines can also be sought out as other options which the authors will discuss later on in this project.

One of the obligations of the Ottawa Treaty is the prohibition of the use of anti-personnel landmines. It also obliges the removal of them. Its target is a mine-free world. Whether or not a mine-free world is a feasible solution remains questionable.[132] However, the removal of landmines to promote development and humanity can not be disputed if conducted properly. Nonetheless, to what extent should mines be cleared?

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[131] Roberts and Williams, *After the Guns Fall Silent*, 33.

[132] ICBL, "The Ottawa Treaty - Article 1," http://www.icbl.org/treaty/text/english (accessed December 10, 2008).

How should they be removed, and if removed, in what order? These are the things that need to be investigated. For example, questions like the following should be asked and answered:

- Should land that has no significant value for the people be cleared of mines? This project has shown that the answer to this question is “no”.
- Should landmines be cleared from more productive land or less productive, or randomly? This project has shown that the answer is all other things equal, that more productive should be cleared first.
- Should landmines be cleared because they have humanitarian impact or because they are linked to developmental impacts, or both? This project has shown that the answer to this question is “both”.
- Should landmines be cleared until they are all removed or should only the impeding ones be cleared? This project has shown that the answer to this question is “impeding ones” not all.

Demining that supports post-conflict rehabilitation, reconstruction, tourism, irrigation, access to infrastructure, and other similar activities pays back the incurred costs. What should be done carefully are the planning and the linking of demining to development, the careful set up of priorities for clearance, and the employment of the proper method of demining such as machine, dogs, manual, or the combination of any of the three demining methods. Demining should not be seen as a standalone program; it should be viewed as promoting other economical developments, and that is where it gets controversial in analyzing the cost-benefit of demining.

Demining today is becoming a wide industry. Many NGOs, commercial companies, and government organizations are involved. Millions of dollars are spent on the industry every year. If demining were not beneficial, so many organizations would not flourish and survive. Therefore, demining is beneficial and should continue to support economic development. Suppose a demining organization is a firm. It can be a NGO, commercial company, or governmental organization. All work towards making a profit. The profit in this case is total revenue minus total cost. A demining organization (now the firm) needs an initial investment. These are setting up an office, training experts, buying equipment and machines as well as vehicles.

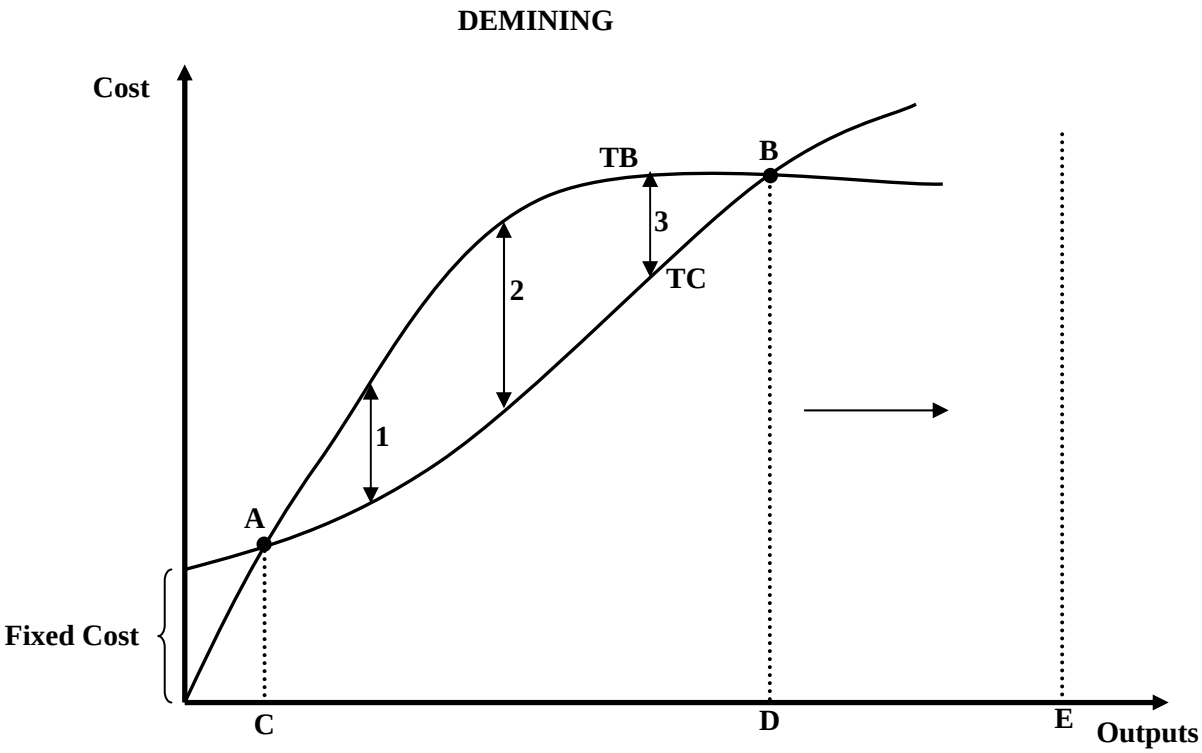

Figure 7. Demining as a Firm

At this point in time, with a lot of expenses as fixed costs, the total cost exceeds the revenue (benefit). After some demining activities and release of land, the value adds up from the land, human lives and livestock, and this equals the total cost (Figure 6, Point A). After effective planning and coordination with development projects and setting up better priorities as well as employing the best method (assigning proper assets), the total benefit exceeds the total cost, which provides the maximum profit (Figure 6, Line 2). When the most rewarding land is demined and less valuable land remains, causalities decline, high priorities finish, then profits start to decline until it reaches the breakeven point (Figure 6, Point B). If demining continues beyond this point the total benefit continues to decline and costs pile up. This can happen as demining continues in minefield areas located in remote areas, mountains, or anywhere that the land is not currently usable or usable in the near future and casualties do not exist (Figure 6, Beyond Line DB). Therefore, according to the authors' analysis, a cost-effective demining

solution is acceptable until Point B, but after that, demining should be abandoned and other options examined such as permanently marking mines (fencing) and relocation.

Before removing landmines, it is important to do a serious cost-benefit analysis. There are humanitarian needs of demining for emergency cases, but the sight of humanity should not blur people from considering the costs and benefits. People should be careful not to spend their resources because of the single reason (killed or injured) in this sector and forget others that may also be killing more people. One example to clarify this is the traffic accident in developing countries. The annual number of deaths and injuries from traffic accidents that could have been alleviated by placing proper traffic signs and educating drivers or taking various other actions are higher than the annual number of deaths and injuries from landmines. However, how many donations are given to reduce traffic accident-related injuries and deaths? Probably not even a dime. Therefore, the deaths and injuries as well as other economic impediments should be calculated reasonably and sensibly to justify a demining action.

On another note, instead of clearing agricultural land that provides a subsistence to, say, twenty people, it may be economically justifiable to provide them the lump sum of the amount of money which could have been used for clearing mines and let them organize to produce something valuable to the community and themselves and live better lives on the profit of their work. Also, a decision-maker may decide to move people from where they used to live into relocation in order not to waste resources to clear the place from landmines. In such a situation, the decision-makers have to consider whether or not the land will be required again in the near future as a result of population increase or other causes. The bottom line is that a thorough cost/benefit analysis should be conducted.

F. IDENTIFYING ALTERNATIVES

Demining is important when there is a short-run emergency and when it promotes long-run development. In the absence of emergency or economic rewards, to hunt any mine laid on the ground is nothing but waste of resources. As discussed earlier every action of demining should be carefully planned. Proper integrations are required to

minimize the cost of demining. The benefit of the land after demining should be calculated against the expenses of the demining. After taking care of all these measures, one might conclude that some land is not worth demining. Therefore, other solutions must be sought in order to minimize other impacts of the landmines. For example, if the land is a residential area, relocation of the people to other places may be required, or it may be required to fence part of it and use the other part. If it was agricultural land, giving people other places as a replacement may be an option.

1. Relocation

Relocation for this option is when people are unable to use their community due to landmines and are forced to live in another selected place where there are no mines. It can also be displaced people who were sheltered in a temporary place but unable to return to their origins as a result of mines. These temporary shelters are decided to be their resident place.

People who live at the proximity of minefield may be relocated by many reasons. The common practices are when government forces them and when they choose to leave or both. A government may want to relocate the people from their settlement for political or economical reasons. In such case government stops from providing services to the people and they will be forced to leave. On the other hand the people may find it economically challenging to stay around the minefield and leaving the place may give them a hope for better. If they were already displaced they may have settled better and decide not to return at all. By all mean this is considered relocation as long as the people are not living in their original location.

To demine a certain place could be more expensive than moving the people to other places. This can happen when little towns are totally devastated by war and all buildings and all or most infrastructures are destroyed by artillery shells or air strikes. Sometimes it is cheaper to build a new town than to remove all the debris and rebuild. An artillery–or air-stricken town will usually contain UXOs. This is because artillery-propelled shells and air-thrown bombs may have been immersed in the debris of the destroyed town. At times landmines may have been laid in the town intentionally. The

problem arises when contractors and construction workers do not feel comfortable working in such places and therefore require a safety guarantee or an assurance of the landmine and UXO clearance of the place. In a law-abiding country no one will be interested in giving a safety guarantee certificate without knowing the details of the whereabouts of the UXOs or mines. This is because of the cost of insurance to back up these guarantees. Therefore, either the landmine and UXO clearance or trusted information about the nonexistence of such landmines and UXO is required.

The standard procedures of the demining of destroyed houses and buildings are different from that of farmlands or other fields. Depending on the threat, one method can be to use armored machines to pick up the debris carefully and place it somewhere else for visual investigation. This may include sifting through the debris before it is dumped. Such a process is hectic and may take forever to finish. The longer it gets, the more costly it becomes.

In a decision about relocation, one has to consider the advantages and disadvantages carefully. When relocation becomes the option, the costs of the replacement of the old facilities with new facilities must be calculated against the demining cost, removal of debris, and rebuilding of the destroyed properties as well as infrastructures. When relocation is chosen, the abandoned areas must be marked or fenced and mine-risk education must be conducted to protect against any possible accidents to the unaware. This can also be another hidden cost worth considering. Also, it is important to remember that one day the place may be needed again.

Relocation may seem simplistic and the preferred option when villagers who live in hut-like houses are threatened by mines. Even if their huts are not destroyed, their lives could be endangered by the presence of landmines around them. Their infrastructures may not be that significant to abandon. Therefore, such communities can be moved and resettled to other safer places with less cost compared to the demining cost should the place be cleared from landmines. It is important to also consider the interest of the people because some communities do not chose to leave and may prefer other options. However, still as long as they are not paying, they may not be given many choices.

2. Temporary Marking

A temporary marking system is a marking system that has a stated finite period of use.[133] Minefield marking is important to prevent risk to people and livestock. When minefields are marked with visible signs, people will be aware and can avoid the risk. Similarly, cattle herders can protect their cattle from entering minefield areas. Temporary markings can be signs or short-term fences. It is a preferred method in a situation where demining capacity is less and cannot cover many places in a shorter period of time. It is intended to inform communities of the presence of mines so that they can protect their families and themselves. Newcomers can also avoid risk by looking at the markers. Such markings are effective when supported by a mine-risk education program. Sometimes the markers may mean nothing to some people. In such a case, mine-risk education is important, because it alerts people to be cautious by showing the standard marking signs.

Temporary marking can be dangerous, because people may be attracted by the marking signs and try to take them. In their attempt, they may be killed or injured. Local people may be alert and manage to take the signs but when other people such as refugees and newcomers enter the community, they may be endangered. Thus, it is not recommended to use markers that have market value to the community.

Marking can also allow the demining process to be cost-effective. Managers can proceed to the most economically viable lands to demine and mark less prioritized land. Therefore, while protecting the few chances of risk brought by marking, temporary marking can boost the benefit of demining by allowing focus on high priority areas first and preventing people from risk by providing awareness.

3. Fencing or Permanent Marking

Fencing or a permanent marking system is a system that has an indefinite period of use, usually requiring maintenance.[134] Demining is an extremely slow, labor-intensive task that consumes lots of human capital. It must be linked to the economic goals of the

[133] UNMAS, “Glossary of Mine Action Terms,” 32.

[134] UNMAS, “Glossary of Mine Action Terms,” 24.

host nation. However, it is not feasible to remove all mines scattered all over the world at once. Many landmines are laid in remote areas, desert plains, and mountains that have no immediate economic value to the population, and therefore such landmines do not pose a significant current threat. These minefields can simply be marked and fenced off permanently until the day comes where demining is necessary. "The Department of State estimates that as many as 30 percent of the mines in the world fall into this group".[135]

Permanent marking should be long-lasting and maintainable in the event of deterioration. Minefields are permanently marked when a demining activity is not pursued in the near future. This is done to protect humans and animals. When land that contains mines does not have an economical impact to the community or the country, in general, lives can be saved by fencing it instead of demining it. Costs that could have been spent for demining can be allocated to other priorities instead.

For example,

> Greece has stated that its minefields along the border with Turkey are clearly defined and marked, well above any standard established by Amended Protocol II and the relevant NATO standards. From 28 August to 2 September 2002, the Landmine Monitor Greece researcher visited these border areas after making a request to the Ministry of Defense. Landmine Monitor observed a 1.7-meter-tall outer fence erected around the minefields, as well as two rows of older fencing further inside the minefields, and warning signs in red phosphorescent paint spaced between one and 1.5 meters apart.[136]

The stronger the fence is the more it protects curious people. Besides, fencing is much cheaper than clearance even though it is not a permanent solution.

When mine-affected countries start to grow and the good years start to show the need for the expansion of infrastructures, the interest in utilizing more land increases. When the population increases, the need for settlement also increases. In such cases the need for removal of the permanent fencing and the clearance of the mines may start to be a priority. At this time demining based on needs and economic impacts may be pursued.

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[135] Bier, "The Economic Impact of Landmines," 661.

[136] ICBL, "Landmine Monitor Report 2003," http://www.icbl.org/lm/2003/greece.html (accessed December 11, 2008).

However, it should be noted that the resources that could have been used in the demining of this area in previous years would have been used for other priorities. For example,

> Egypt marked-off mined areas following the Second World War and these areas have remained untouched since. But, as the Egyptian population continues to expand, the Egyptian government is now searching for ways to clear and develop the old battlefields into economically productive regions. The demining organization, working within the parameters of economic development, must determine priorities.[137]

Thus, fencing can be an alternative to demining.

[137] Bier, "The Economic Impact of Landmines," 661.

V. CONCLUSION AND RECOMMENDATIONS

Landmines are a risk to humanity and an impediment to post-conflict recovery and development. Landmines affect, but are not limited to, developing countries that are emerging from conflict. They are also obstructions to economies and peace of the world. Landmines discourage refugees from returning home and become financial burdens to international and neighboring countries. The more landmines that obstruct post-war recovery, the more they keep countries in poverty, which in turn leads to tensions and conflicts. Conflicting nations also affect world peace and security as well as economies. Some mines located in remote areas are removed by terrorists and used to bomb towns. Thus, developed nations should support more demining, because most mines are produced by them and they are involved indirectly. Therefore, landmines are obstructions to development and a threat to humanity for the world, and the reduction of their impact is imperative.

Landmines have been severely hurting war-torn nations for years. From the moment the international community noticed their brutality, there have been growing activities and solid measures taken to reduce their harsh effects. Today, a majority of nations of the world have signed the Ottawa Treaty and are fulfilling their obligations. Such measures are crucial in avoiding future uses of such weapons and therefore the suffering of human beings from mines could end soon. Even though countries such as China, the United States, Russia, and others have not signed the treaty, with the growing pressure and reduced demand for the use of mines, the authors are optimistic that these nations will fulfill the goals of the Ottawa Treaty. However, unless the treaty is somehow empowered, there is no enforcement to the member states to abide by their obligations.

As landmines are classified as obstructions to development, there is no other foreseeable solution than demining as long as it is rewarding. When there is no clear reward from demining land, money should not be wasted to do so. When demining is chosen as the solution, it should be carefully planned and coordinated with other developmental programs; it should be conducted based on priorities that are relevant to

the country; and it should be based on the best employment of demining assets to reduce operational costs and maximize benefits. Unless carefully planned and coordinated, demining is fragile and it is difficult to justify the gains from the costs.

To make demining cost-effective, planning and coordination at the execution level is not enough. Donor countries should look closely into the systems of their donation mechanisms. Donors should give incentives to countries that put forth extra efforts to challenge the problem. They should use incentives to encourage countries that quickly declare themselves impact free. In addition, donors should also reward organizations that are cost-effective. If there are no incentives, operators of demining activities may slow down their operations and donor requests will last forever. Similarly, the mine-affected countries will be receptive to the extension of demining. Moreover, donors need to make sure that their funds are reaching the intended targets.

In the demining industry, there is an incentive to exaggerate the problem, an incentive that must be dealt with carefully. Donors fund UN, NGOs, and national programs for demining. In a situation where these organizations are neither paying nor sharing the contribution, they will spend it recklessly. In fact, their preference will be not to end the program because the NGOs and government organizations care about their jobs and prefer to extend demining timeframes, or demine land even if there is no economic value. Therefore, donors should put a solution in place to protect themselves from demining organizations.

In the event of minefields that have less value if demined, permanent marking accompanied by mine-risk education is important. When demining is more costly than its benefit, it should not be done. Remember, there are a lot of problems in developing countries that are killing more people that badly need funding. Therefore, mined lands that are not intended to add value and are not planned for current or near future use should be fenced, or other relevant alternatives to demining should be adopted.

There are a lot of organizations participating in the mine action industry. Most of them come with their own source of funding, so they do not have to compete for funds based on performance. The lack of competition hinders innovation and may be one of the

reasons that demining is so costly. Had there been a competition, there could have been new equipment and advanced methodologies invented to reduce the cost of demining as well as speed up the process. Moreover, there are organizations in the mine action industry that were created because they saw the potential for funding. They still exist regardless of any meaningful achievement. This may be attributable to the donors and mine action donation system failure; however, it is also due to the absence of competition in the industry.

There exist organizations in the mine action industry that do duplicated work but manage to get funding, while there are better-suited organizations that do not get funding. On the other hand funds are decreasing and there is a demand for cost-effectiveness. Cost savings can start from removing organizations that do duplicated work and giving the work to the best-suited organizations. Therefore, transaction costs spent to administer the organization should be spent on effectively getting resources to the intended target.

Organizations involved with demining often ignore military institutions. However, the military is expected to be well-informed, skilled, and ideal for the discipline. They may have been perceived as un-trusted institutions to conduct humanitarian business. Nonetheless, this is a misperception that causes a great deal of expense that could have been saved. Military institutions that participate in many humanitarian affairs show proof of excellence in many occasions. In fact, the best management people and the most skilled people in demining are usually retired military people hired as civilians. The only difference is the uniform. Moreover, military institutions are permanent organizations that are worth using in order to save start-up costs and to transfer the responsibility in the absence of foreign funding. Therefore, the widespread involvement of military institutions is important to save money.

Many NGOs and international organizations are extending their noble assistance to many mine-affected countries to alleviate the landmine problem imposed on these countries. While they are assisting the mine-affected countries, they should also transfer the skills to enable these countries to self-sustain. This is because mine action is cheaper to perform through national capacities than international capacities. However, this does not happen in most cases, and may be due to joint problems. First, some NGOs do not

like to transfer the capacity because of the fear of replacement. Second, the nationals abuse the resources after the transfer of capacity and sometimes do not like to take initiatives to receive the skills. Third, when the NGOs leave the country, the funds also disappear with them. There are NGOs that are still operating in one's country for more than ten years even though demining is easy to learn and do.

The mine action community has developed a standard operating procedure where demining is monitored and cleared land is assured against the standard. This standard is high-quality that works for developed nations. However, most mine-affected countries are developing countries. The level of risk aversion in the two categories is different. Developed countries tend to avoid risk more than developing countries. Thus, the standards could have been developed to a tolerable level of the developing countries, thereby saving more funds.

In general, landmines are a risk to humanity and an impediment to economic development. To alleviate the impact, a long-term solution like the Ottawa Treaty is crucial because if all states come under the umbrella of the Treaty, states will not produce, stockpile, transfer and use landmines, and a mine-impact-free world can possibly be achieved. To eliminate the existing impact to humanity and development, demining, marking, fencing and relocation are the options. Demining a land is significant only when it can bring benefits compared to the associated costs. This can be achieved when it is linked to long-term development, and planned, prioritized, and coordinated carefully. Demining for humanitarian purposes should be short-lived and for emergency aid purposes in order to justify its costs and benefits. In the absence of justification for demining, other alternative should be considered.

Mine action is a new emerging industry, so there is a lot of potential for future studies. There are big enough funds available in the industry but it is awkward finding detailed data, and a study on the cost-benefit analysis of demining is difficult. There are also alternatives to demining but they lack detailed cost implications to compare them to demining. Therefore, the authors recommend a further study on the cost-benefit of demining and the alternatives.

APPENDIX

Table 1. Academic Organizations in Mine Action Industry[138]

	Organization	Org. Type	Activity Details	Country of Operation
1	Africa Topics Magazine	Academic	Other	United Kingdom
2	American University Center for the Global South (CGS)	Academic	Mine Risk Education	USA
3	Applied Physics Institute WKU	Academic	Research and Technology	USA
4	Argonne National Laboratory (DOE)	Academic	Research and Technology	USA
5	Assistance to Mine-Affected Communities (AMAC)	Academic	Research and Technology	Afghanistan, Angola
6	Auburn University, Department of Electrical Engineering	Academic	Research and Technology	USA
7	Baltic International Centre for Human Education	Academic	Mine Risk Education	Latvia
8	British Medical Journal (BMJ)	Academic	Other	United Kingdom
9	C.P.A.D.D. (Centre de Perfectionnement aux Actions post-conflictuelles de Déminage et Dépollution)	Academic	Clearance and Detection	Benin, Burkina Faso
10	Canadian Landmine Research Network	Academic	Mine Risk Education	Canada
11	Carnegie Mellon University	Academic	Clearance and Detection	USA
12	Center for Disaster and Humanitarian Assistance Medicine	Academic	Humanitarian Coordination	Chad
13	Chalmers University of Technology	Academic	Research and Technology	Sweden
14	Colorado State University	Academic	Research and Technology	USA
15	Cooperative Research Center for Sensor Signal and Information Processing	Academic	Research and Technology	Australia
16	Cranfield Mine Action Unit (CMA)	Academic	Research and Technology	United Kingdom
17	Danish Engineer and NBC School (DANDEC)	Academic	Mine Risk Education	Denmark
18	Duke University	Academic	Research and Technology	USA
19	ELOHIM PEREZIM Demining Research Centre	Academic	Awareness	South Africa
20	ETRO dept. Vrije Universiteit Brussel	Academic	Clearance and Detection	Belgium
21	EUDEM2	Academic	Clearance and Detection	Belgium
22	EXPLODET Collaboration	Academic	Research and Technology	Italy

[138] James Madison University, Mine Action Information Center, Global Mine Action Registry, http://maic.jmu.edu/gmar/search.asp, (accessed April 05, 2009).

23	Fachschule des Heeres fuer Technik	Academic	Research	Germany
24	Faculty of Health Sciences, Queen's University	Academic	Mine Risk Education	Canada
25	Fraunhofer Institute	Academic	Research and Technology	Germany
26	Gaston Z. Ortigas Peace Institute/Ateneo de Manila University	Academic	Humanitarian Coordination	Philippines
27	Georgia Institute of Technology	Academic	Research and Technology	USA
28	Global Care Unlimited	Academic	Other	Bosnia-Herzegovina
29	Global Environmental Change and Human Security, University of California, Irvine (GECHS-UCI)	Academic	Research and Technology	USA
30	Greenwich University	Academic	Other	United Kingdom
31	Harvard Humanitarian Robotics	Academic	Demining Equipment	Sri Lanka, USA
32	Indonesia Peace, Arms Control & Disarmament Institute	Academic	Advocacy and Diplomacy	Indonesia
33	Institut für Experimentalphysik III, Ruhr-Universität Bochum	Academic	Research and Technology	Germany
34	Institut für Höchstfrequenztechnik und Elektronik (IHE)	Academic	Research and Technology	Germany
35	Institute for Conflict Analysis and Resolution (ICAR), George Mason University	Academic	Other	USA
36	Institute for Peace & Conflict Studies	Academic	Other	Afghanistan, Bangladesh
37	Institute for Practical Research	Academic	Research and Technology	Other, Somalia
38	IRCTR	Academic	Research and Technology	USA
39	International Institute for Geo-Information Science and Earth Observation (ITC)	Academic	Clearance and Detection	Cyprus, Mozambique
40	International School for Security and explosives Education	Academic	Awareness	Bahrain, Bosnia-Herzegovina
41	Iowa State University	Academic	Research and Technology	USA
42	Kaliningrad State University	Academic	Research and Technology	Russian Federation
43	MAIC at JMU	Academic	Awareness	USA
44	Massachusetts Institute of Technology	Academic	Research and Technology	USA
45	McMaster University	Academic	Research and Technology	Canada
46	Messiah College Landmine Action Project	Academic	Clearance and Detection	USA
47	Mine Action Academy	Academic	Mine Risk Education	Croatia
48	Monash University	Academic	Research and Technology	Australia
49	Monash University Malaysia	Academic	Clearance and Detection	Malaysia
50	The University of Mississippi	Academic	Research and Tech.	USA

51	National Chengchi University	Academic	Other	Taiwan
52	National Council for the Social Studies	Academic	Mine Risk Education	USA
53	New Mexico Institute of Mining and Technology	Academic	Research and Technology	USA
54	Ohio State University Electro Science Laboratory (ESL)	Academic	Research and Technology	USA
55	Queen's University	Academic	Other	Canada
56	Royal Military Academy of Belgium	Academic	Research and Technology	Belgium
57	Stevens Institute of Technology	Academic	Research and Technology	USA
58	Sudanese Nuer Canadian of British Columbia Development	Academic	Advocacy and Diplomacy	Kenya, Sudan
59	Swiss Federal Institute of Technology - Lausanne	Academic	Other	Switzerland
60	Swiss Federal Institute of Technology - Zurich	Academic	Other	Switzerland
61	Technical University of Denmark	Academic	Research and Technology	Denmark
62	Texas A&M Int. UXO Training Program	Academic	Clearance and Detection	USA
63	The University of Western Australia, School of Mechanical Engineering	Academic	Demining Equipment	Australia
64	Third World Studies Center (TWSC)	Academic	Mine Risk Education	Philippines
65	Uniformed Services University of Health Sciences	Academic	Other	USA
66	University of Alabama in Huntsville	Academic	Research and Technology	USA
67	University of Alberta	Academic	Research and Technology	Canada
68	University of Auckland	Academic	Research and Technology	Australia
69	University of Balamand Landmines Resource Center (LMRC)	Academic	Mine Risk Education	Iraq, Jordan
70	University of Brescia	Academic	Research and Technology	Italy
71	University of Bristol	Academic	Research and Technology	United Kingdom
72	University of Cape Town	Academic	Research and Technology	South Africa
73	University of Denver Center for Teaching International Relations (CTIR)	Academic	Awareness	USA
74	University of Edinburgh	Academic	Research and Technology	United Kingdom
75	University of Florence	Academic	Research and Technology	Italy
76	University of Florida	Academic	Research and Technology	USA
77	University of Kansas	Academic	Research and Technology	USA
78	University of Los Andes, Electrical Engineering Dept.	Academic	Research and Technology	Colombia

79	University of Missouri-Columbia	Academic	Research and Tech.	USA
80	University of Missouri-Rolla	Academic	Clearance and Detection	USA
81	University of Nebraska-Lincoln	Academic	Research and Technology	USA
82	University of Ottawa Center for Executive Development	Academic	Other	Canada
83	University of Pennsylvania	Academic	Research and Technology	USA
84	University of Queensland	Academic	Research and Technology	Australia
85	University of Rhode Island	Academic	Clearance and Detection	USA
86	University of Saskatchewan	Academic	Clearance and Detection	Canada
87	University of Texas at Arlington	Academic	Research and Technology	USA
88	University of Virginia	Academic	Research and Technology	USA
89	University of Warwick	Academic	Research and Technology	United Kingdom
90	University of Zimbabwe (Centre for Defense Studies)	Academic	Research and Technology	Zimbabwe
91	Virginia Tech University	Academic	Research and Technology	USA

Table 2. Corporate Firms in Mine Action Industry[139]

	Organization	Org. Type	Activity Details	Country of Operation
1	A.B.C. Appalti Bonifiche Costruzioni	Corporate	Clearance and Detection	Angola, Bosnia-Herzegovina
2	Aardvark Clear Mine Ltd	Corporate	Clearance and Detection	Afghanistan, Angola
3	ACTRA Rehabilitation Associates, Inc.	Corporate	Humanitarian Coordination	USA
4	aDeDe	Corporate	Clearance and Detection	Belgium
5	Amey VECTRA Integrated Simulation and Analysis (ISA)	Corporate	Research and Technology	United Kingdom
6	AMK Export Import Consulting	Corporate	Clearance and Detection	Turkey
7	AMK Risk Management	Corporate	Clearance and Detection	Turkey
8	Amtech Aeronautical Limited	Corporate	Research and Technology	Canada
9	Applied Ordnance Technology, Inc.	Corporate	Research and Tech.	USA
10	Applied Research Associates (ARA)	Corporate	Research and Technology	Canada, USA
11	Armor Group Mine Action	Corporate	Clearance and Detection	Albania, Angola
12	Asian Landmine Solutions (ALS)	Corporate	Clearance and Detection	Cambodia, Laos

[139] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

13	Ave Fenix LTDA	Corporate	Awareness	Chile
14	AVS Mine Action Consultants	Corporate	Demining Equipment	Afghanistan, Angola
15	Babylon Gold	Corporate	Clearance and Detection	Iraq
16	BACTEC International Limited	Corporate	Clearance and Detection	Angola, Kuwait
17	Ballistic Body Armour (Pty) Ltd	Corporate	Research and Technology	Bosnia-Herzegovina
18	Bayswater Consulting Group Inc.	Corporate	Research and Technology	Canada
19	BIGAT GmbH Waste Processing Technology Engineering Ltd.	Corporate	Other	Germany
20	Biokinetics and Associates Ltd.	Corporate	Research and Technology	Canada
21	Black Mountain Safety & Health, Inc.	Corporate	Awareness	USA
22	Bluefin Cold Cutting Systems	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
23	Bombs Away	Corporate	Clearance and Detection	Cambodia, Guam
24	Booz, Allen & Hamilton	Corporate	Research and Technology	Argentina, Australia
25	BRTRC Technology Research Corporation	Corporate	Research and Technology	USA
26	C King Associates Ltd.	Corporate	Clearance and Detection	United Kingdom
27	CEIA SpA	Corporate	Clearance and Detection	Afghanistan, Angola
28	CEIA USA	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
29	CGTVA	Corporate	Clearance and Detection	Croatia, Mozambique
30	Chilport UK Ltd.	Corporate	Clearance and Detection	Eritrea, Laos
31	Chirgwin Services Group Pty Ltd.	Corporate	Clearance and Detection	Australia, Cambodia
32	Concept Engineering Group, Inc.	Corporate	Clearance and Detection	USA
33	Concurrent Technology Corporation	Corporate	Clearance and Detection	Belgium, Germany
34	Critical Solutions International	Corporate	Clearance and Detection	Afghanistan, Iraq
35	CSG Demining Consultants	Corporate	Clearance and Detection	Afghanistan, Australia
36	D&M "SLASHBUSTER"® Vegetation Clearance Equipment	Corporate	Demining Equipment	USA
37	DANMINAR A/S	Corporate	Awareness	Afghanistan, Albania
38	DC Comics	Corporate	Mine Risk Education	Bosnia-Herzegovina, Costa Rica
39	Deutsche Gesellschaft für Technische Zusammenarbeit/German Agency for Technical Cooperation (GTZ)	Corporate	Humanitarian Coordination	Mozambique
40	DFI International	Corporate	Research and Technology	USA
41	Diehl BGT Defense GmbH & Co. KG	Corporate	Other	Germany
42	DOK-ING	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
43	Duro Dakovic Special Vehicles	Corporate	Demining Equipment	Croatia
44	E&I International Ltd.	Corporate	Advocacy and Diplomacy	Afghanistan, Angola
45	E&I MKD Corp	Corporate	Advocacy and Diplomacy	Afghanistan, Azerbaijan

46	ECC, Munitions Response Services	Corporate	Clearance and Detection	Australia, Germany
47	ECSI	Corporate	Clearance and Detection	Afghanistan, Angola
48	EMERKOM of Russia	Corporate	Humanitarian Coordination	Russian Federation
49	EOD Technology Inc. (EODT)	Corporate	Clearance and Detection	Afghanistan, Germany
50	ERSAY TRANSPORT	Corporate	Advocacy and Diplomacy	Afghanistan, Armenia
51	Explosive and Ordnance Demilitarisation Solutions Ltd.	Corporate	Awareness	Albania, Bosnia-Herzegovina
52	Export Capital LLC	Corporate	Other	Ecuador
53	FGM, Inc.	Corporate	Research and Technology	USA
54	Förderkreis der Wirtschaft St. Barbara	Corporate	Clearance and Detection	Angola
55	Foster Wheeler Environmental	Corporate	Clearance and Detection	USA
56	Garrett Metal Detectors; Countermine/ERW Division	Corporate	Demining Equipment	USA
57	Geomines	Corporate	Clearance and Detection	Angola, Bosnia-Herzegovina
58	Geosoft Inc.	Corporate	GIS and Mapping	Australia, Brazil
59	Global Co., Ltd.	Corporate	Clearance and Detection	Japan
60	Global Mine Detection, LLC	Corporate	Clearance and Detection	USA
61	Global Training Academy	Corporate	Clearance and Detection	Afghanistan, Iraq
62	Guelle Mine Action Consulting GMAC GmbH	Corporate	Awareness	Germany, Mozambique
63	Human Rights Advocates International, Inc.	Corporate	Humanitarian Coordination	Cambodia, Laos
64	Humanitaeres Minenraeumen/Humanitarian Demining, Consultant	Corporate	Clearance and Detection	Bosnia-Herzegovina
65	HYDREMA	Corporate	Clearance and Detection	Denmark, Germany
66	Inter-Continental Safety Systems Inc. (ISS)	Corporate	Demining Equipment	Canada
67	International Intelligence Limited	Corporate	Demining Equipment	Afghanistan, Iraq
68	Istanbul	Corporate	Clearance and Detection	Turkey
69	Japan Science and Technology Agency (JST)	Corporate	Clearance and Detection	Japan
70	Kardan Demining Group	Corporate	Awareness	Afghanistan
71	KIMAQS Co.Ltd	Corporate	Program Management and Coordination	Cambodia
72	LEXON Technologies, LLC	Corporate	Clearance and Detection	USA
73	LNY Services Co.	Corporate	Clearance and Detection	USA
74	Lockheed Martin Corporation	Corporate	Research and Technology	USA
75	Lockwood Beck Limited	Corporate	Clearance and Detection	United Kingdom
76	Lotus Security Equipments	Corporate	Demining Equipment	India
77	LVP Technology	Corporate	Research and Technology	Afghanistan, Angola
78	Maavarim - Civil Engineering LTD.	Corporate	Clearance and Detection	Albania, Angola
79	MACC International Ltd.	Corporate	Awareness	Bosnia-Herzegovina
80	Management Support Technology, Inc. (MSTI)	Corporate	Research and Technology	USA

81	Manufactured Lightning Inc.	Corporate	Clearance and Detection	USA
82	Marbach Consulting Group	Corporate	Research and Technology	Canada
83	Mechem Consultants	Corporate	Clearance and Detection	Afghanistan, Angola
84	Med-Eng Systems Inc.	Corporate	Clearance and Detection	Afghanistan, Armenia
85	Mine Action & Clearance Centre Malaysia	Corporate	Awareness	Azerbaijan, Bahrain
86	Mine Action Associates	Corporate	Advocacy and Diplomacy	Angola, Bosnia-Herzegovina
87	Mine Action International Ltd.	Corporate	Clearance and Detection	Afghanistan, Armenia
88	Mine Action Iran (MAI)	Corporate	Clearance and Detection	Iran
89	MINELINK(PVT)LTD	Corporate	Awareness	Angola, Burundi
90	MineTech International	Corporate	Clearance and Detection	Afghanistan, Chad
91	MineWolf Systems	Corporate	Demining Equipment	Angola, Bosnia-Herzegovina
92	MKA*DEMING Ltd.	Corporate	Clearance and Detection	Croatia, Serbia
93	MPWD Limited	Corporate	Clearance and Detection	Angola, Belgium
94	MREL Specialty Explosive Products Limited	Corporate	Clearance and Detection	Canada
95	Naval Research Laboratory	Corporate	Research and Technology	USA
96	Newgrace International Exhibition Planning Co. Ltd.	Corporate	Information Management	China
97	Niagara Prosthetics & Orthotics Corporation	Corporate	Research and Technology	Cambodia, El Salvador
98	Norwegian Demining Consortium	Corporate	Clearance and Detection	Afghanistan, Croatia
99	OC, Inc.	Corporate	Other	USA
100	Olive Branch Society	Corporate	Advocacy and Diplomacy	USA
101	Omega Contact International	Corporate	Other	Japan
102	Omega Foundation	Corporate	Other	United Kingdom
103	Orthopedie Delcros S A	Corporate	Other	Algeria, France
104	Pharmacom Corporation	Corporate	Research and Technology	China, USA
105	Phoenix Clearance Ltd.	Corporate	Awareness	Cambodia, Laos
106	Planit EOD	Corporate	Clearance and Detection	Iraq, United Kingdom
107	PLANIT EOD Limited	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
108	Ploughshare Technologies	Corporate	Research and Technology	USA
109	ProDive Solutions	Corporate	Awareness	Angola, Congo
110	Prosthetic Consulting	Corporate	Prosthetics	Denmark, France
111	QinetiQ	Corporate	Clearance and Detection	United Kingdom
112	Qualissol Consultants	Corporate	Clearance and Detection	Albania, Angola
113	Regency Clinical Research	Corporate	Clearance and Detection	Egypt
114	Remote Sensing Centre Potsdam	Corporate	Research and Technology	Germany
115	RONCO Consulting Corporation	Corporate	Clearance and Detection	Afghanistan, Albania

116	RU-RU	Corporate	Awareness	Croatia, Sudan
117	RU-RU-DOK-ING Ltd Sudan	Corporate	Awareness	Croatia, Sudan
118	S-3 Services, Inc.	Corporate	Clearance and Detection	Cambodia, Thailand
119	S3 AG	Corporate	Awareness	Afghanistan, Angola
120	SAA International	Corporate	Demining Equipment	Afghanistan, Iraq
121	Safe Seas International	Corporate	Clearance and Detection	Afghanistan, France
122	Samad Rubber Works (Pvt.) Ltd.	Corporate	Clearance and Detection	Cambodia, Kuwait
123	Scanjack AB	Corporate	Clearance and Detection	Croatia, Iraq
124	Shadow Robot Project	Corporate	Research and Technology	United Kingdom
125	Skimatics Consulting	Corporate	Advocacy and Diplomacy	Cambodia, Vietnam
126	Sky Research, Inc.	Corporate	Clearance and Detection	USA
127	SPARTA, Inc	Corporate	Clearance and Detection	USA
128	Special Services Group International Inc	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
129	Star Mountain, Inc.	Corporate	Research and Technology	USA
130	Strategic Financial Planning Systems, Inc.	Corporate	Clearance and Detection	Afghanistan, France
131	Strategic Systems, Inc.	Corporate	Clearance and Detection	Afghanistan, France
132	Tactical Training Institute	Corporate	Clearance and Detection	Afghanistan, Andorra
133	The Development Initiative Limited	Corporate	Advocacy and Diplomacy	Afghanistan, Iraq
134	Threat Resolution Ltd	Corporate	Research and Technology	Albania, Angola
135	Transimpex	Corporate	Clearance and Detection	Ukraine
136	UNIEXPL LTD	Corporate	Clearance and Detection	Croatia, Russian Federation
137	UXB International, Inc.	Corporate	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
138	Warner Brothers	Corporate	Mine Risk Education	USA
139	WAY INDUSTRY	Corporate	Clearance and Detection	Afghanistan, Albania
140	Yard Demining International	Corporate	Awareness	Afghanistan, Congo,

Table 3. Government Organizations in Mine Action Industry[140]

	Organization	Org. Type	Activity Details	Country of Operation
1	Eritrea Mine Action Center	Government	Advocacy and Diplomacy	Eritrea
2	American Embassy - Hanoi	Government	Other	Vietnam
3	Atlantic Council of the United States	Government	Other	USA
4	Auswaertiges Amt (German Foreign Ministry)	Government	Other	Germany
5	Botschaft Belgien (Belgian Embassy to Germany)	Government	Other	Germany

[140] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

6	Canadian Center for Mine Action Technologies (CCMAT)	Government	Research and Technology	Afghanistan, Bosnia-Herzegovina
7	Canadian International Development Agency (CIDA)	Government	Clearance and Detection	Afghanistan, Cambodia
8	Center for Disease Control and Prevention (CDC)	Government	Survivor and Victim Assistance	USA
9	Colombian Air Force	Government	Demining Equipment	Colombia
10	Danish Ministry of Foreign Affairs	Government	Humanitarian Coordination	Afghanistan, Denmark
11	DASD (PK/HA)	Government	Other	USA
12	Department of Energy (U.S.)	Government	Research and Technology	USA
13	Embassy of the Republic of Haiti (Taiwan)	Government	Other	Taiwan
14	Federal Ministry of Health - Bosnia and Herzegovina	Government	Survivor and Victim Assistance	Bosnia-Herzegovina
15	Foreign Affairs Canada	Government	Clearance and Detection	Canada
16	Foreign Relations Department of Quang Tri	Government	Clearance and Detection	Vietnam
17	GRUEX COEBU	Government	Clearance and Detection	Colombia
18	Humanitarian Demining Training Center (HDTC)	Government	Humanitarian Coordination	Azerbaijan, Iraq
19	Instituto Nacional De Desminagem	Government	Mine Risk Education	Mozambique
20	International Trust Fund for Demining and Mine Victims Assistance	Government	Clearance and Detection	Albania, Armenia
21	Lao National Unexploded Ordnance Programme (UXO LAO)	Government	Clearance and Detection	Laos
22	Lawrence Livermore National Laboratory	Government	Research and Technology	USA
23	Lebanon Mine Action Center	Government	Advocacy and Diplomacy	Lebanon
24	Legislative Yuan, Taiwan	Government	Other	Taiwan
25	Ministry of Coordination of Social Action (MICAS)	Government	Humanitarian Coordination	Mozambique
26	Ministry of Defence, Finland	Government	Advocacy and Diplomacy	Finland
27	Ministry of Defense, Republic of Croatia	Government	Other	Croatia
28	National Humanitarian demining Programme for development	Government	Advocacy and Diplomacy	Mauritania
29	National Research Institute of Astronomy and Geophysics, Cairo, Egypt	Government	Clearance and Detection	Egypt
30	National Research Laboratory Remote Sensing Division	Government	Research and Technology	USA
31	Office of Science & Technology Policy - White House	Government	Other	USA
32	Regional Center for Underwater Demining	Government	Clearance and Detection	Bosnia-Herzegovina, Croatia
33	SIBAT Israel Ministry of Defense	Government	Other	Israel

Table 4. International Organizations in Mine Action Industry[141]

	Organization	Org. Type	Activity Details	Country of Operation
1	AMPHIBIA	IO	Awareness	Bosnia-Herzegovina, Croatia
2	European Community Humanitarian Office (ECHO)	IO	Humanitarian Coordination	Macedonia, FYR
3	European Union	IO	Clearance and Detection	Afghanistan, Angola
4	Geneva International Center for Humanitarian Demining (GICHD)	IO	Advocacy and Diplomacy	Afghanistan, Albania,
5	International Society for Prosthetics and Orthotics (ISPO)	IO	Research and Technology	Argentina, Australia
6	Organization of American States (OAS)	IO	Advocacy and Diplomacy	Colombia, Costa Rica,
7	Stabilisation Force (SFOR)	IO	Clearance and Detection	Bosnia-Herzegovina
8	United Nations Children's Fund (UNICEF)	IO	Humanitarian Coordination	Afghanistan, Albania
9	United Nations Development Program (UNDP)	IO	Advocacy and Diplomacy	Afghanistan, Angola
10	United Nations Development Programme (UNDP), Armenia	IO	Advocacy and Diplomacy	Armenia
11	United Nations Mine Action Coordination Centre, South Lebanon	IO	Clearance and Detection	Lebanon
12	United Nations Mine Action Service (UNMAS)	IO	Clearance and Detection	Afghanistan, Cong
13	United Nations Office for Project Services (UNOPS)	IO	Clearance and Detection	Afghanistan, Azerbaijan
14	World Bank	IO	Clearance and Detection	Afghanistan, Albania
15	World Food Programme (WFP)	IO	Humanitarian Coordination	Afghanistan, Albania

Table 5. Military Organizations in Mine Action Industry[142]

	Organization	Org. Type	Activity Details	Country of Operation
1	Air Mobility Warfare Center (AMWC)	Military	Other	USA
2	Alliant Techsystems (ATK)	Military	Other	Argentina, Australia
3	Army Headquarters, Engineers Directorate	Military	Research and Technology	Zimbabwe
4	Belgian Royal Military Academy	Military	Other	Germany
5	HUKdo. (Heeresunterstuetzungskommando)	Military		Germany
6	Institute for Military Engineering Excellence in Southern Africa (IMEESA)	Military	Mine Risk Education	Mozambique, South Africa
7	Inter-American Defense Board (IADB)	Military	Clearance and Detection	Costa Rica, Guatemala

[141] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

[142] Ibid.

8	International Mine Action Training Centre (Eastern Africa)	Military	Advocacy and Diplomacy	Kenya
9	U.S. Army ARDEC	Military	Other	USA
10	U.S. Army Cold Regions Research	Military	Other	USA
11	U.S. Army Engineer School	Military	Mine Risk Education	USA
12	U.S. Army, NVESD	Military	Research and Technology	USA
13	U.S. Department of Defense OASD/ SO/LIC	Military	Clearance and Detection	USA
14	United Kingdom Mine Information and Training Centre (UKMITC)	Military	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
15	US Army Aviation & Missile Command	Military	Other	USA
16	USCENTCOM/CCJ-5 (Demining)	Military	Clearance and Detection	USA
17	USEUCOM/ECSO-J37 (Demining)	Military	Clearance and Detection	USA
18	USSOCOM/SOOP-OAC (Demining)	Military	Clearance and Detection	USA
19	USSOUTHCOM/J334 (Demining)	Military	Other	USA

Table 6. Mine Action Centers and National Demining Organizations[143]

	Organization	Org. Type	Activity Details	Country of Operation
1	Albanian Mine Action Executive	MAC/NDO	Clearance and Detection	Albania
2	Azerbaijan National Agency for Mine Action (ANAMA)	MAC/NDO	Clearance and Detection	Azerbaijan
3	Bosnia and Herzegovina Mine Action Center (BHMAC)	MAC/NDO	Clearance and Detection	Bosnia-Herzegovina
4	Cambodian Mine Action Centre (CMAC)	MAC/NDO	Clearance and Detection	Cambodia
5	Center of Demining Ecuador	MAC/NDO	Awareness	Ecuador, Peru
6	Centro Peruano de Acción Contra las Minas Anti-Personal (CONTRAMINAS)	MAC/NDO	Advocacy and Diplomacy	Peru
7	Chad National Mine Action Center	MAC/NDO	Clearance and Detection	Chad
8	Croatian Mine Action Center (CROMAC)	MAC/NDO	Clearance and Detection	Croatia
9	Cyprus Mine Action Center	MAC/NDO	Advocacy and Diplomacy	Cyprus
10	Ethiopian Mine Action Office (EMAO)	MAC/NDO	Advocacy and Diplomacy	Ethiopia
11	Instituto Nacional de Remoação de Obstáculos e Engenhos	MAC/NDO	Clearance and	Angola

[143] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

	expolosivos (INAROEE)		Detection	
12	Islamic Republic Of Iran Mine Action Center (IRMAC)	MAC/NDO	Awareness	Iran
13	Mine Action Center for Afghanistan (MACA)	MAC/NDO	Advocacy and Diplomacy	Afghanistan
14	Mine Action Center Mozambique	MAC/NDO	Clearance and Detection	Mozambique
15	Mine Action Coordination Centre South Lebanon	MAC/NDO	Other	Lebanon
16	Nagorno Karabakh MAC	MAC/NDO	Awareness	Azerbaijan
17	National Demining Commission (CND) Mozambique	MAC/NDO	Clearance and Detection	Mozambique
18	National Demining Commission (NCD) Nicaragua	MAC/NDO	Clearance and Detection	Nicaragua
19	National Humanitarian Demining Office - Mauritania	MAC/NDO	Advocacy and Diplomacy	Mauritania
20	Somaliland Mine Action Centre (SMAC)	MAC/NDO	Advocacy and Diplomacy	Somaliland
21	Thailand Mine Action Center (TMAC)	MAC/NDO	Clearance and Detection	Thailand
22	Ukrainian Mine Action Coordination Center	MAC/NDO	Advocacy and Diplomacy	Eritrea, Iraq
23	United Nations - Mine Action Coordination Centre Southern Lebanon	MAC/NDO	Clearance and Detection	Lebanon
24	United Nations Mission for Ethiopia and Eritrea Mine Action Coordination Center (UNMEE MACC)	MAC/NDO	Clearance and Detection	Eritrea, Ethiopia
25	Zimbabwe Mine Action Centre	MAC/NDO	Clearance and Detection	Zimbabwe

Table 7. NGOs and International NGOs in Mine Action Industry[144]

	Organization	Org. Type	Activity Details	Country of Operation
1	Accelerated Demining Program (ADP)	NGO/INGO	Clearance and Detection	Mozambique
2	Action Against Hunger	NGO/INGO	Survivor and Victim Assistance	Afghanistan, Angola
3	Action by Churches Together International (ACT)	NGO/INGO	Humanitarian Coordination	Afghanistan, Albania
4	Action For National Development (Action)	NGO/INGO	Advocacy and Diplomacy	Pakistan
5	Action Solidarite Tiers Monde	NGO/INGO	Advocacy and Diplomacy	Luxembourg
6	Action Aid	NGO/INGO	Survivor and Victim Assistance	Afghanistan, Bangladesh
7	Acumen Fund	NGO/INGO	Humanitarian Coordination	Egypt, Pakistan
8	Adopt-A-Minefield (UK)	NGO/INGO	Clearance and Detection	Afghanistan, Angola

[144] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

9	Adopt-A-Minefield (United Nations Association of the USA)	NGO/INGO	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
10	Adventist Development and Relief Agency International (ADRA)	NGO/INGO	Humanitarian Coordination	Afghanistan, Albania
11	Afghan Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Pakistan
12	Afghan Red Crescent Society (ARCS)	NGO/INGO	Humanitarian Coordination	Afghanistan
13	Afghan Technical Consultants (ATC)	NGO/INGO	Clearance and Detection	Afghanistan
14	Africa Policy Information Center (APIC)	NGO/INGO	Advocacy and Diplomacy	USA
15	African Humanitarian Action (AHA)	NGO/INGO	Advocacy and Diplomacy	Ethiopia, Uganda
16	African Women's Alliance for Mobilizing Action (AWAMA)	NGO/INGO	Advocacy and Diplomacy	Mozambique
17	Albanian Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Albania
18	Albanian Red Cross	NGO/INGO	Humanitarian Coordination	Albania
19	Algerian Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Algeria
20	American Friends Service Committee (AFSC)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
21	American Land Mine Disposal Foundation	NGO/INGO	Clearance and Detection	USA
22	American Limb & Orthopedic Co.	NGO/INGO	Prosthetics	USA
23	American Physical Society	NGO/INGO	Other	USA
24	American Red Cross	NGO/INGO	Survivor and Victim Assistance	Albania, Armenia
25	American Refugee Committee	NGO/INGO	Mine Risk Education	Bosnia-Herzegovina, Congo
26	Amputee Coalition of America (ACA)	NGO/INGO	Survivor and Victim Assistance	USA
27	Amputee Coalition of America National Limb Loss Information Center (ACA NLLIC)	NGO/INGO	Survivor and Victim Assistance	USA
28	Angola Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Angola
29	Angolan Red Cross	NGO/INGO	Humanitarian Coordination	Angola
30	Anti Landmijn Stichting/Anti Landmine Foundation	NGO/INGO	Fundraising and Sponsorship	Netherlands
31	Antimining Friends Committee	NGO/INGO	Advocacy and Diplomacy	Albania
32	APOPO	NGO/INGO	Clearance and Detection	Belgium, Mozambique
33	Arab Net of Researchers on Landmine and ERW	NGO/INGO	Humanitarian Coordination	Algeria, Bahrain
34	Armenian Red Cross Society	NGO/INGO	Humanitarian Coordination	Armenia
35	Asian Disaster Preparedness Center (ADPC)	NGO/INGO	Advocacy and Diplomacy	Cambodia, Laos
36	Association de Recherche de Techniques Innovantes en Déminage Humanitaire (ARTID)	NGO/INGO	Clearance and Detection	France
37	Association for Aid and Relief (AAR)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
38	AUSTCARE	NGO/INGO	Awareness	Afghanistan, Angola
39	Australian Lutheran World Service	NGO/INGO	Humanitarian Coordination	Australia, Cambodia

40	Austrian Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Austria
42	AVSI	NGO/INGO	Advocacy and Diplomacy	Uganda
43	Azerbaiajan Mine Victims Association (AMVA)	NGO/INGO	Awareness	Azerbaijan
44	Azerbaijan Red Crescent Society	NGO/INGO	Humanitarian Coordination	Azerbaijan
45	Bakhtar Associates	NGO/INGO	Demining Equipment	USA
46	Banning of Landmines-Sri Lanka Movement	NGO/INGO	Advocacy and Diplomacy	Sri Lanka
47	Belarus Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Belarus
48	Bellanet	NGO/INGO	Research and Technology	Canada
49	BGM Social service Centre Trust	NGO/INGO	Awareness	India
50	BOCS Foundation	NGO/INGO	Awareness	Hungary
51	Brazilian Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Brazil
52	Burkinabe Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Burkina Faso
53	Cambodia Campaign to Ban Landmines (CCBL)	NGO/INGO	Advocacy and Diplomacy	Cambodia
54	Cambodia Trust	NGO/INGO	Survivor and Victim Assistance	Cambodia
55	Cambodian Handicraft Association for Landmine and Polio Disabled (CHA)	NGO/INGO	Survivor and Victim Assistance	Cambodia
56	Cambodian National Volleyball League (Disabled)	NGO/INGO	Awareness	Cambodia
57	Cambodian Red Cross	NGO/INGO	Humanitarian Coordination	Cambodia
58	Cambodian School of Prosthetics and Orthotics	NGO/INGO	Survivor and Victim Assistance	Cambodia
59	Canadian Association for Mine Explosive Ordnance (CAMEO) Security	NGO/INGO	Clearance and Detection	Afghanistan, Angola
60	Canadian International Demining Corps (CIDC)	NGO/INGO	Clearance and Detection	Algeria, Belarus
61	Canadian Landmine Detection Dogs Society	NGO/INGO	Clearance and Detection	Canada, Sri Lanka
62	Canadian Landmine Foundation	NGO/INGO	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
63	CARE Australia	NGO/INGO	Advocacy and Diplomacy	Burma (Myanmar), Cambodia
64	CARE Brazil	NGO/INGO	Humanitarian Coordination	Brazil
65	CARE Canada	NGO/INGO	Mine Risk Education	Afghanistan, Albania
66	CARE Denmark	NGO/INGO	Mine Risk Education	Bolivia, Ghana
67	CARE Deutschland	NGO/INGO	Clearance and Detection	Afghanistan, Bosnia-Herzegovina
68	CARE France	NGO/INGO	Mine Risk Education	Afghanistan, Angola
69	CARE Nederland	NGO/INGO	Mine Risk Education	Albania, Angola
70	CARE UK	NGO/INGO	Mine Risk Education	Afghanistan, Angola
71	CARE USA	NGO/INGO	Mine Risk Education	Afghanistan, Angola
72	Casualty Care Research Center	NGO/INGO	Humanitarian	USA
73	Catholic Relief Services	NGO/INGO	Clearance and Detection	Afghanistan, Albania

74	Center for International Rehabilitation (CIR)	NGO/INGO	Mine Risk Education	Afghanistan, USA
75	Central American Land Mine Survivors Project (CALMS)	NGO/INGO	Survivor and Victim Assistance	El Salvador, Honduras
76	Centre for Humanitarian Programmes	NGO/INGO	Humanitarian Coordination	United Kingdom
77	Centre for Peacemaking & Community Development	NGO/INGO	Humanitarian Coordination	Russian Federation
78	Centro Integral de Rehabilitacion de Colombia (CIREC)	NGO/INGO	Survivor and Victim Assistance	Colombia
79	Chechen Committee of the International Humanitarian Movement "Refugees Against Landmines"	NGO/INGO	Advocacy and Diplomacy	Georgia
80	Child-to-Child Trust, Institute of Education, University of London	NGO/INGO	Humanitarian Coordination	United Kingdom
81	Children and Armed Conflict Unit	NGO/INGO	Survivor and Victim Assistance	Afghanistan, Albania
82	Christian Children's Fund	NGO/INGO	Humanitarian	USA
83	Church World Service	NGO/INGO	Humanitarian Coordination	Somalia
84	CIET International	NGO/INGO	Mine Risk Education	Afghanistan, Angola
85	Citizens Association for Mine Protection ZOM	NGO/INGO	Awareness	Bosnia-Herzegovina
86	Clear Path International (CPI)	NGO/INGO	Fundraising and Sponsorship	Afghanistan, Cambodia
87	Colombo Friend in Need Society	NGO/INGO	Survivor and Victim Assistance	Sri Lanka
88	Community Agency for Social Enquiry	NGO/INGO	Humanitarian Coordination	South Africa
89	Community Motivation and Development Organization (CMDO)	NGO/INGO	Humanitarian Coordination	Pakistan
90	Cooperative Orthotic and Prosthetic Enterprise (COPE)	NGO/INGO	Advocacy and Diplomacy	Laos
91	COPE International Inc. (Consultants for Orthotic and Prosthetic Education)	NGO/INGO	Mine Risk Education	Afghanistan, Cambodia
92	Costa Rican Red Cross	NGO/INGO	Humanitarian	Costa Rica
93	Counterpart International	NGO/INGO	Humanitarian Coordination	Azerbaijan, Barbados
94	Croatian Campaign to Ban Landmines (CCBL)	NGO/INGO	Advocacy and Diplomacy	Croatia
95	Croatian Mine Victims Association	NGO/INGO	Survivor and Victim Assistance	Croatia
96	Croatian Red Cross	NGO/INGO	Humanitarian Coordination	Croatia
97	CZ team, Ltd.	NGO/INGO	Clearance and Detection	Algeria, Angola
98	Danish Demining Group	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Iraq
99	Defense for Children International	NGO/INGO	Advocacy and Diplomacy	Israel
100	Demining Agency for Afghanistan (DAFA)	NGO/INGO	Clearance and Detection	Afghanistan
101	Dervish Mine Clearance Ltd.	NGO/INGO	Clearance and Detection	United Kingdom
102	Developing & Promotion Economical-Humanity Organization	NGO/INGO	Clearance and Detection	Iraq

103	Development Technology Workshop (DTW)	NGO/INGO	Clearance and Detection	Angola, Bosnia-Herzegovina
104	DHARMAPA FOUNDATION - MAWANELLA- SRI LANKA	NGO/INGO	Awareness	Sri Lanka
105	Direct Relief International	NGO/INGO	Humanitarian Coordination	Afghanistan, Algeria
106	Disability Action Council	NGO/INGO	Advocacy and Diplomacy	Cambodia
107	Disability and Development Partners (DDP)	NGO/INGO	Advocacy and Diplomacy	Angola, Bangladesh
108	Disabled People International (DPI)	NGO/INGO	Advocacy and Diplomacy	Canada
109	Disarmament and Nonviolence	NGO/INGO	Advocacy and Diplomacy	Georgia
110	Eden Social Welfare Foundation	NGO/INGO	Advocacy and Diplomacy	Taiwan
111	EMERGENCY: Life Support for Civilian War Victims	NGO/INGO	Humanitarian Coordination	Afghanistan, Algeria
112	Engineers Without Borders/Ingenieurs Sans Frontiers Canada	NGO/INGO	Mine Risk Education	Canada
113	Environmental Law Institute	NGO/INGO	Mine Risk Education	USA
114	Ethiopian Demining Project	NGO/INGO	Clearance and Detection	Ethiopia
115	Ethiopian Red Cross Society	NGO/INGO	Humanitarian Coordination	Ethiopia
116	Fort Enterprise	NGO/INGO	Clearance and Detection	Croatia, Iraq
117	Foundation Together: Regional Center for the Psychosocial Well-being of Children	NGO/INGO	Survivor and Victim Assistance	Slovenia
118	Genesis Project	NGO/INGO	Advocacy and Diplomacy	Bosnia-Herzegovina
119	Geneva Call (GC)	NGO/INGO	Advocacy and Diplomacy	Angola, Bangladesh
120	Georgian White Cross Union	NGO/INGO	Humanitarian	Armenia, Azerbaijan
121	German Initiative to Ban Landmines	NGO/INGO	Clearance and Detection	Afghanistan, Angola,
122	Global Life Support	NGO/INGO	Humanitarian Coordination	Afghanistan, Bosnia-Herzegovina
123	Global Volunteer Network	NGO/INGO	Humanitarian Coordination	China, Ecuador
124	Golden West Humanitarian Foundation	NGO/INGO	Clearance and Detection	Cambodia, Colombia
125	HALO Trust	NGO/INGO	Clearance and Detection	Afghanistan, Angola
126	HALO USA	NGO/INGO	Clearance and Detection	Afghanistan, Angola
127	HAMAP DEMINEURS	NGO/INGO	Clearance and Detection	Cambodia, France
128	Handicap International Belgium (HIB)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
129	Handicap International UK	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
130	Health Volunteers Overseas	NGO/INGO	Mine Risk Education	Vietnam
131	Help Handicapped International	NGO/INGO	Other	Afghanistan, Burundi
132	Helpful Friend	NGO/INGO	Advocacy and Diplomacy	Nepal
133	Helsinki Committee for Human Rights in Serbia	NGO/INGO	Awareness	Albania, Andorra
134	HOPE International	NGO/INGO	Awareness	Afghanistan, Pakistan
135	Hope Worldwide-Pakistan	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Nepal,
136	Human Rights Watch	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania

137	Humane Society of the U.S.	NGO/INGO	Advocacy and Diplomacy	USA
138	Humanitarian Aid Medical Development (HMD/HAMD) / HMD Response International	NGO/INGO	Awareness	Angola, Bosnia-Herzegovina
139	Humanity Dog	NGO/INGO	Clearance and Detection	Bosnia-Herzegovina, Norway
140	Humpty Dumpty Institute	NGO/INGO	Clearance and Detection	Angola, Eritrea
141	Hungarian Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Hungary
142	ICBL Georgian Committee	NGO/INGO	Advocacy and Diplomacy	Georgia
143	Indian Institute for Peace, Disarmament & Environmental Protection (IIPDEP)	NGO/INGO	Advocacy and Diplomacy	India
144	Institute of Rehabilitation of Republic of Slovenia	NGO/INGO	Survivor / Victim Assistance	Slovenia
145	Integrated Rural Development Society (IRDS)	NGO/INGO	Advocacy and Diplomacy	Bangladesh, Indonesia
146	InterAction	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Brazil
147	International Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
148	International Center for the Advancement of Community-Based Rehabilitation	NGO/INGO	Policy	Bosnia-Herzegovina, Canada
149	International Committee of the Red Cross	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
150	International Development Research Centre (IDRC)	NGO/INGO	Research and Technology	Argentina, Brazil
151	International Eurasia Press Fund	NGO/INGO	Awareness	Azerbaijan
152	International Federation of Red Cross and Red Crescent Societies (IFRC)	NGO/INGO	Humanitarian Coordination	Afghanistan, Albania
153	International Mine Initiative (I.M.I.)	NGO/INGO	Awareness	Bosnia-Herzegovina, Iraq
154	International Physicians for the Prevention of Nuclear War (IPPNW)	NGO/INGO	Advocacy and Diplomacy	Australia, India
155	International Rescue Committee (IRC)	NGO/INGO	Mine Risk Education	Afghanistan, Albania
156	Iranian Minorities Human Rights Organization (IMHRO)	NGO/INGO	Advocacy and Diplomacy	Iran, Iraq
157	Iraq Mine and UXO Clearance Organization (IMCO)	NGO/INGO	Clearance and Detection	Iraq
158	Japan Alliance for Humanitarian Demining Support (JAHDS)	NGO/INGO	Clearance and Detection	Cambodia, Thailand
159	Japan Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Japan
160	Japan Center for Conflict Prevention	NGO/INGO	Advocacy and Diplomacy	Sri Lanka
161	Japan International Cooperation Agency (JICA)	NGO/INGO	Clearance and Detection	Bolivia, Bosnia-Herzegovina
162	Just World Trust (JUST)	NGO/INGO	Humanitarian Coordination	Malaysia
163	Justice & Peace Commission of Thailand	NGO/INGO	Humanitarian Coordination	Thailand
164	KARUNA	NGO/INGO	Humanitarian	Nepal
165	Kenya Coalition of NGOs Against Landmines (KCAL)	NGO/INGO	Advocacy and Diplomacy	Kenya
166	Kessler Institute for Rehabilitation	NGO/INGO	Survivor and Victim Assistance	USA
167	Kuwait Red Crescent Society	NGO/INGO	Humanitarian Coordination	Kuwait

168	Kwatukumbuchire Malawi	NGO/INGO	Awareness	Malawi
169	La PASIP	NGO/INGO	Advocacy and Diplomacy	Indonesia
170	Landmine Action UK	NGO/INGO	Advocacy and Diplomacy	Sri Lanka, Sudan
171	Landmine Relief Fund	NGO/INGO	Awareness	Cambodia
172	Landmine Struggle Center (LSC)	NGO/INGO	Clearance and Detection	Egypt
173	Landmine Survivors Network (LSN)	NGO/INGO	Survivor and Victim Assistance	Bosnia-Herzegovina, Colombia
174	Lebanese Red Cross (LRC)	NGO/INGO	Awareness	Lebanon
175	Legal Research & Resource Center for Human Rights	NGO/INGO	Advocacy and Diplomacy	Egypt
176	Limbs for Life Foundation	NGO/INGO	Survivor and Victim Assistance	Turkey, USA
177	Lutheran World Federation (LWF)	NGO/INGO	Humanitarian Coordination	Angola, Bangladesh
178	Lutheran World Relief (LWR)	NGO/INGO	Clearance and Detection	Bolivia, Burkina Faso
179	MAG America	NGO/INGO	Awareness	Angola, Cambodia
180	Marshall Legacy Institute (MLI)	NGO/INGO	Advocacy and Diplomacy	Angola, Bosnia-Herzegovina
181	Massachusetts Peace Action - Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	USA
182	Mauritius Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Mauritius
183	Medical Care Development International	NGO/INGO	Awareness	Sudan
184	Medico International	NGO/INGO	Advocacy and Diplomacy	Angola, Brazil
185	Mennonite Central Committee (MCC)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
186	Mercy Ships International Operations Center	NGO/INGO	Advocacy and Diplomacy	Netherlands, South Africa
187	Mine Action Center Georgia	NGO/INGO	Awareness	Georgia
188	Mine Action Program for Afghanistan	NGO/INGO	Advocacy and Diplomacy	Afghanistan
189	Mine Clearance Planning Agency (MCPA)	NGO/INGO	Clearance and Detection	Afghanistan, Vietnam
190	Mine Detection Dog Center (MDC)	NGO/INGO	Clearance and Detection	Afghanistan
191	MINE FREE Planet	NGO/INGO	Advocacy and Diplomacy	Sri Lanka
192	Mine Victims Fund (MVF) - U.S.	NGO/INGO	Humanitarian Coordination	USA
193	Mine Victims Fund UK	NGO/INGO	Survivor and Victim Assistance	United Kingdom
194	Mine Warfare Association (MINWARA)	NGO/INGO	Humanitarian Coordination	USA
195	Mines Action Canada	NGO/INGO	Advocacy and Diplomacy	Canada
196	Mines Advisory Group (MAG)	NGO/INGO	Advocacy and Diplomacy	Angola, Burundi
197	Mines Awareness Trust	NGO/INGO	Advocacy and Diplomacy	Kenya, Kosovo, FYR
198	Mines Clearance International (MCI)	NGO/INGO	Clearance and Detection	Bosnia-Herzegovina, Cambodia
199	Mineseeker Foundation	NGO/INGO	Clearance and Detection	United Kingdom
200	Miracles	NGO/INGO	Prosthetics	Bosnia-Herzegovina

201	Mission Aviation Fellowship of Canada (MAF)	NGO/INGO	Humanitarian Coordination	Canada
202	Mozambican Campaign Against Landmines (CMCM)	NGO/INGO	Advocacy and Diplomacy	Mozambique
203	Mozambique Red Cross Society (MRC)	NGO/INGO	Advocacy and Diplomacy	Mozambique
204	Myanmar Red Cross Society	NGO/INGO	Humanitarian Coordination	Burma (Myanmar)
205	Namibian Campaign to Ban Landmines (NCBL)	NGO/INGO	Advocacy and Diplomacy	Namibia
206	National Committee on American Foreign Policy and Huntington Associates	NGO/INGO	Advocacy and Diplomacy	USA
207	National Laotian-Americans for Justice	NGO/INGO	Humanitarian	Laos, USA
208	National Mine Association	NGO/INGO	Information Management	India, Nepal
209	Nepal Campaign to Ban Landmines (NCBL)/Women Development Society	NGO/INGO	Advocacy and Diplomacy	Nepal
210	New Zealand Campaign Against Landmines (NZ CALM)	NGO/INGO	Advocacy and Diplomacy	New Zealand
211	NGO Committee on Disarmament	NGO/INGO	Advocacy and Diplomacy	USA
212	Nicaraguan Red Cross	NGO/INGO	Humanitarian Coordination	Nicaragua
213	Nigeria Landmine Action Group	NGO/INGO	Advocacy and Diplomacy	Angola, Chad
214	NOBLE VOCATIONAL TRAINING WELFARE CENTRE	NGO/INGO	Awareness	India
215	Nordic Demining Research Forum (NDRF)	NGO/INGO	Clearance and Detection	Finland, Norway
216	Norwegian Peoples Aid (NPA)	NGO/INGO	Advocacy and Diplomacy	Angola, Bosnia-Herzegovina
217	One Sri Lanka Foundation	NGO/INGO	Advocacy and Diplomacy	Sri Lanka
218	Open Society Institute Landmines Project	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
219	Operation Landmine	NGO/INGO	Clearance and Detection	Cambodia, Cuba
220	Operation LIMBS	NGO/INGO	Survivor and Victim Assistance	USA
221	Organization for Mine Clearance and Afghan Rehabilitation (OMAR)	NGO/INGO	Clearance and Detection	Afghanistan
222	Overseas Development Institute	NGO/INGO	Humanitarian Coordination	Eritrea, Gambia
223	OXFAM International	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
224	Padang Lutheran Christian Relief	NGO/INGO	Awareness	Sudan
225	Pakistan International human rights Organization	NGO/INGO	Awareness	Afghanistan, Norway
226	Pakistan International Human Rights Organization (PIHRO)	NGO/INGO	Advocacy and Diplomacy	Pakistan
227	Patrick J. Leahy War Victims Fund (LWVF) (USAID)	NGO/INGO	Humanitarian Coordination	Afghanistan, Albania
228	Peace Union of Finland	NGO/INGO	Advocacy and Diplomacy	Finland
229	Peacekeeping Centre	NGO/INGO	Advocacy and Diplomacy	Canada
230	People to People International (PTPI)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
231	People's Aid Coordinating Committee (PACCOM)	NGO/INGO	Humanitarian Coordination	Vietnam
232	Phoenix Humanitarian Demining	NGO/INGO	Clearance and Detection	Germany

233	Physicians Against Landmines (PALM)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
234	Physicians for Global Survival	NGO/INGO	Advocacy and Diplomacy	Canada, Iraq
235	Physicians for Human Rights (PHR)	NGO/INGO	Advocacy and Diplomacy	Mozambique, USA
236	POWER(Peoples Organization for Welfare and Entire Relief)	NGO/INGO	Awareness	India
237	Promoters of Liberian and Canadian Relationship (POLCR) Inc.	NGO/INGO	Advocacy and Diplomacy	Liberia
238	Prosthetics Outreach Foundation (POF)	NGO/INGO	Advocacy and Diplomacy	Bangladesh, Vietnam
239	Prosthetics Research Study	NGO/INGO	Humanitarian Coordination	USA
240	Quest Explosive Disposal Ltd	NGO/INGO	Awareness	Hungary, United Kingdom
241	Reach the Child With It (RECIT)	NGO/INGO	Humanitarian Coordination	Ghana
242	Red Crescent Society of Azerbaijan	NGO/INGO	Humanitarian Coordination	Azerbaijan
243	Red Crescent Society of Tajikistan	NGO/INGO	Humanitarian Coordination	Tajikistan
244	Red Cross of the Democratic Republic of the Congo	NGO/INGO	Humanitarian Coordination	Congo, Democratic Republic of the
245	Red Cross of Viet Nam	NGO/INGO	Humanitarian Coordination	Vietnam
246	Red Cross Society of Bosnia and Herzegovina	NGO/INGO	Humanitarian Coordination	Bosnia-Herzegovina
247	Red Cross Society of Eritrea	NGO/INGO	Humanitarian Coordination	Eritrea
248	Red Cross Society of Georgia	NGO/INGO	Humanitarian Coordination	Georgia
249	Refugee Relief International	NGO/INGO	Survivor and Victim Assistance	Afghanistan, Bosnia-Herzegovina
250	Refugees International	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
251	Rehabilitation Institute of Chicago	NGO/INGO	Humanitarian Coordination	USA
252	Relief Azerbaijan	NGO/INGO	Clearance and Detection	Azerbaijan
253	Roots of Peace	NGO/INGO	Clearance and Detection	Afghanistan, Angola
254	Russian Physicians for the Prevention of Nuclear War	NGO/INGO	Humanitarian Coordination	Russian Federation
255	Russian Red Cross Society	NGO/INGO	Humanitarian Coordination	Russian Federation
256	Salu Self-Help Blind and Handicapped Association	NGO/INGO	Survivor and Victim Assistance	Ethiopia
257	Sann Trust	NGO/INGO	Awareness	Pakistan
258	Save the Children	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
259	Science against Mines	NGO/INGO	Clearance and Detection	Cambodia, Germany
260	Singapore Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Singapore
261	Social-life and Agricultural Development Organization (SADO)	NGO/INGO	Humanitarian Coordination	Somalia

262	Society for Counter-Ordnance Technology (SCOT)	NGO/INGO	Research and Technology	USA
263	Somali Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Somalia
264	Somali Demining &UXO Action Group Centre	NGO/INGO	Advocacy and Diplomacy	Switzerland
265	Somali Red Crescent Society	NGO/INGO	Humanitarian Coordination	Somalia
266	Somalia Demining Action Group	NGO/INGO	Clearance and Detection	Somalia
267	South African Institute of International Affairs (SAIIA)	NGO/INGO	Research and Technology	South Africa
268	South East Asian Rural Development Fund, Inc.	NGO/INGO	Clearance and Detection	Cambodia
269	South Florida Landmine Action Group (SFLAG)	NGO/INGO	Advocacy and Diplomacy	USA
270	Southern Somali Mine Action Association	NGO/INGO	Advocacy and Diplomacy	Somalia
271	Spirit of Soccer	NGO/INGO	Mine Risk Education	Bosnia-Herzegovina
272	Sports Facilitators for All	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Cambodia
273	Sri Lanka Red Cross Society	NGO/INGO	Humanitarian Coordination	Sri Lanka
274	Standing Tall Australia	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Australia
275	STOP Mines	NGO/INGO	Awareness	Bosnia-Herzegovina, Serbia
276	STS Somalia	NGO/INGO	Humanitarian Coordination	Somalia
277	Sudan Campaign to Ban Landmines	NGO/INGO	Mine Risk Education	Sudan
278	Sudanese Red Crescent	NGO/INGO	Humanitarian Coordination	Sudan
279	SUNRIDER DISABLE WELFARE FOUNDATION	NGO/INGO	Advocacy and Diplomacy	Bangladesh
280	Survey Action Center (SAC)	NGO/INGO	Survey	Afghanistan, Angola
281	Swat Youth Front	NGO/INGO	Awareness	Pakistan
282	Swedish Armed Forces Dog Instruction Centre (SAFDIC)	NGO/INGO	Clearance and Detection	Sweden
283	Swedish Peace and Arbitration Society (SPAS)	NGO/INGO	Advocacy and Diplomacy	Russian Federation, Sweden
284	Swedish Working Dog Association	NGO/INGO	Clearance and Detection	Sweden
285	Swiss Campaign to Ban Landmines	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Angola
286	Swiss Foundation for Mine Action (FSD)	NGO/INGO	Clearance and Detection	Albania, Angola
287	Swiss Mine & Explosive Detection Dogs Society (SMEDDS)	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
288	Terra Segura International (TSI)	NGO/INGO	Clearance and Detection	USA
289	The Asia Foundation	NGO/INGO	Clearance and Detection	Afghanistan, Bangladesh
290	The Field Relief Agency of Taiwan (FRA)	NGO/INGO	Humanitarian Coordination	Taiwan
291	THE NEST - Social Research and Resource Centre	NGO/INGO	Awareness	India
292	The Nigerian Landmine Action Group	NGO/INGO	Advocacy and Diplomacy	Nigeria
293	The Pakistan Society for the Rehabilitation of the Disabled	NGO/INGO	Survivor and Victim Assistance	Pakistan
294	Tolerance Foundation	NGO/INGO	Humanitarian Coordination	Bosnia-Herzegovina, Czech Republic

295	Trauma Care Foundation	NGO/INGO	Humanitarian Coordination	Afghanistan, Cambodia
296	U.S. Committee for Refugees	NGO/INGO	Humanitarian Coordination	Afghanistan, Albania
297	Uganda Red Cross Society	NGO/INGO	Humanitarian Coordination	Uganda
298	UK Working Group on Landmines	NGO/INGO	Advocacy and Diplomacy	Kosovo, FYR, United Kingdom
299	Ukrainian Humanitarian Demining Task Force (UHDTF)	NGO/INGO	Clearance and Detection	Iraq, Lebanon
300	Ukrainian Peacekeepers Association	NGO/INGO	Advocacy and Diplomacy	Afghanistan
301	UNICEF Landmines and Small Arms Team Humanitarian Policy and Advocacy Unit	NGO/INGO	Advocacy and Diplomacy	USA
302	United Methodist Committee on Relief (UMCOR)	NGO/INGO	Humanitarian Coordination	Afghanistan, Angola
303	UVS International	NGO/INGO	Clearance and Detection	Australia, Austria
304	Verification Research, Training and Information Centre (VERTIC)	NGO/INGO	Advocacy and Diplomacy	United Kingdom
305	Vietnam Assistance for the Handicapped	NGO/INGO	Survivor and Victim Assistance	Vietnam
306	WADEM Land Mine Task Force	NGO/INGO	Advocacy and Diplomacy	Germany
307	Wanglel Care International Services	NGO/INGO	Awareness	Sudan
308	Women's International League for Peace & Freedom (WILPF)	NGO/INGO	Advocacy and Diplomacy	Albania, Argentina
309	WORK FOR PEACE	NGO/INGO	Mine Risk Education	Iraq
310	World EOD Foundation (WEODF)	NGO/INGO	Clearance and Detection	United Kingdom
311	World Health Organization (WHO)	NGO/INGO	Survey	Afghanistan, Albania
312	World Hope Foundation	NGO/INGO	Awareness	Ghana, India
313	World Rehabilitation Fund, Inc.	NGO/INGO	Humanitarian Coordination	Cambodia, Dominican Republic
314	World Vision International	NGO/INGO	Advocacy and Diplomacy	Afghanistan, Albania
315	Youth Approach for Development & Cooperation (YADC)	NGO/INGO	Mine Risk Education	Bangladesh
316	Youth for Democracy and Human Rights	NGO/INGO	Awareness	Somalia
317	Yugoslav Red Cross	NGO/INGO	Humanitarian Coordination	Yugoslavia
318	Zambian Campaign to Ban Landmines (ZCBL)	NGO/INGO	Advocacy and Diplomacy	Zambia

Table 8. Other Organizations in Mine Action Industry[145]

	Organization	Org. Type	Activity Details	Country of Operation
1	AFRICAN DECISIONS	Other	Awareness	Algeria, Angola
2	Albanian Development Fund	Other	Awareness	Albania
3	AMPHIBIA Ltd.	Other	Awareness	Bosnia-Herzegovina, Croatia
4	Disaster Reduction Consultant	Other	Advocacy and Diplomacy	Afghanistan, Angola
5	H3Tec. LLC.	Other	Clearance and Detection	USA
6	Japan International Cooperation System	Other	Demining Equipment	Afghanistan, Cambodia
7	Jushware	Other	Clearance and Detection	Bosnia-Herzegovina, Croatia
8	Lao Techno Engineering	Other	Other	Burma (Myanmar), Laos
9	Law Office of W. Robb Graham, LLC	Other	Other	USA
10	Mine Clearance International (MCI)	Other	Awareness	Angola, Botswana
11	Mine Action	Other	Awareness	Egypt
12	Navy MSO Association	Other	Clearance and Detection	USA
13	REDBNAG EOD CONSULTANCY	Other	Awareness	Albania, Angola
14	RK Consulting	Other	Awareness	Afghanistan, Bosnia-Herzegovina
15	Roehll	Other	Clearance and Detection	Bosnia-Herzegovina, Germany
16	Rotarians for Mine Action	Other	Awareness	Afghanistan, Australia
17	Royal Hawaiian Institute for Landmine Removal	Other	Clearance and Detection	USA
18	Rural Alliance for Child Advocacy and Welfare (RACAW)	Other	Advocacy and Diplomacy	Cameroon
19	SLIRI	Other	Advocacy and Diplomacy	Sudan
20	Swedish Dog Protection Fund	Other		Sweden
21	TMP Demining	Other	Clearance and Detection	Serbia

[145] James Madison University, Mine Action Information Center, Global Mine Action Registry, n.p.

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