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The Impact of Landmines and Explosive Remnants of War on Food Security: THE LEBANESE CASE

by Henrique Garbino [Swiss Foundation for Mine Action]

The year 2017 was the third in a row of an exceptionally high number of mine victims. According to the *Landmine and Cluster Munition Monitor*, in 2017 alone, 7,239 people became casualties of landmines or explosive remnants of war (ERW), of which at least 2,793 were killed.[1,2] Apart from their direct physical effects, landmines and ERW also restrict access to basic resources such as food and water, limit the use of key infrastructure, and both force and restrict migration.[2] This article focuses on the impact of landmines and ERW on food security, with an emphasis in food production.

Even though the relationship between landmines and food production may seem obvious, theoretically, there are many different possible mechanisms linking them, depending on the affected country or region. Thus, the aim of this article is twofold. First, it provides an overview of the possible theoretical mechanisms connecting landmines and ERW to decreased food security. Second, the theory is applied and assessed in the case of Lebanon.

The case study is presented based on specific literature on the Lebanese case, and on reports from the Lebanon Mine Action Centre (LMAC), the *Landmine and Cluster Munition Monitor*, the United Nations, and other international organizations. Whereas landmines and ERW still present a grave threat to civilians and pose a significant impediment for the development of affected communities, this article finds that landmines and ERW alone insufficiently explain food insecurity in Lebanon.

Nexus Between Landmines and Food Security

Researchers, policy-makers, and practitioners have been increasingly aware of the often-unremembered impacts of armed conflict. Previous research has focused on the environmental damage caused by warfare and its effects on land management and migration.[3,4] Drawing on this specific literature and other papers on landmines, cluster munitions, ERW, and improvised explosive devices (IEDs), as well as mine action reports, it can be assessed that landmines impact food security via six different and somewhat reinforcing mechanisms: access denial (to arable land, water sources, and infrastructure), loss of livestock, land degradation, reduced workforce, financial constraints, and aid dependency.

Food security is impacted by landmines via the lack of access to arable land. Minefields are basically laid either to provide protection to military bases and strategic resources or as obstacles to the enemy's freedom of movement.[5] For the latter, it is likely that minefields will cover a large extent of otherwise unprotected areas, such as open fields and plains. Alternatively, militaries and nonstate armed groups frequently lay nuisance minefields, aimed at delaying and disorganizing the enemy.[5,6] Therefore, large areas of arable and pasture lands are contaminated by landmines, for example, in Lebanon, Angola, Mozambique, Cambodia, Sinai, Kuwait, and Iraq.[7] Access denial is further extended due to the suspected presence of landmines or ERW.

Landmines are also laid near water sources to reinforce natural obstacles, such as beaches, rivers, lakes, and irrigation ditches.[8] Likewise, dams and hydroelectric power plants, often perceived as strategic targets, may be protected by minefields.[5] The consequent lack of access to water sources further compromises food security, especially livestock, animal production, and herder communities. In addition, minefields aim to restrict access to infrastructure. Key roads, highways, railways, ports, and airports, as well as stations, bridges, and crossings are likely to be mined during conflicts. In this sense, landmines also limit the maintenance

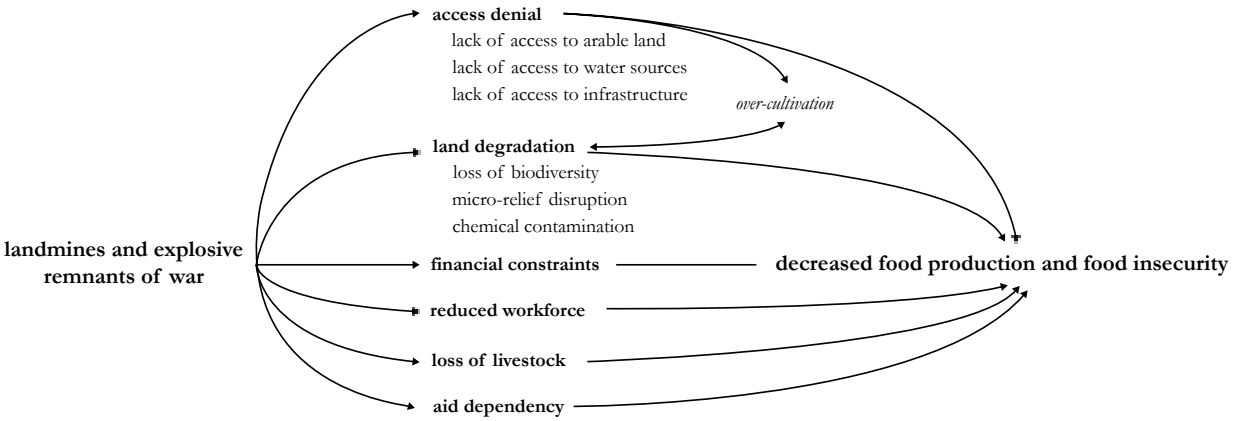

Figure 1. Summary of causal mechanisms (adapted from Berhe and GICHD).[7,9]
All graphics courtesy of the author.

and construction of new infrastructure,[7,9] which indirectly impacts the food production chain.

Livestock is directly affected by mines, especially large mammals such as cattle, horses, camels, and even sheep.[10–12] Moreover, when humanitarian demining programs are absent, communities rely on rudimentary techniques to assess whether an area is safe or not. In many cases, this means letting cattle graze in suspected hazardous areas.[7,13]

Landmines may cause land degradation in roughly four ways: through loss of biodiversity, micro-relief disruption (disruption of the first layer of soil), chemical contamination, and over-cultivation.[7,9] First, fauna and flora are affected by the physical and chemical effects of the detonation of landmines and ERW. This is particularly relevant for conflicts fought in forests[14] or on routes of migratory animals. In addition, when arable land is not accessible, communities turn to forests as their last resort for fuel (i.e., wood), food, and shelter. This effect is aggravated by the concentration of refugees and internally displaced persons, who are considerably limited by minefields and concentrate around safe areas. It must be emphasized, though, that in some mined and contaminated areas biodiversity is actually very high due to the lack of human interference (e.g. the Korean peninsula's demilitarized zone).[15]

Demining techniques may also contribute to loss of biodiversity and deforestation. While removing small bushes and plants is a standard process in both mechanical[16] and manual mine clearance,[17] some communities and demining organizations set minefields on fire in order to clear the vegetation and facilitate future work.[7]

Conversely, some authors argue that vegetation loss, micro-relief disruption, or even burning in mine clearance operations may have a positive effect in biodiversity by creating different mixes of habitats across the landscape.[18] Moreover, as it relates to food production, both manual and mechanical mine clearance techniques arguably facilitate future land use for agricultural purposes, by clearing the field and effectivelly ploughing it.

Likewise, micro-relief disruption is caused by the accidental detonation of landmines and ERW, the use of fire as a rudimentary demining technique,[7] and standard demining procedures. During standard manual mine clearance, deminers are required to remove the first layers of soil not only for every landmine or ERW they find but for each metal fragment detected, including shrapnel and bullet casings. Moreover, if the condition of the mines or ERW do not allow for their removal and further destruction in a specific area, those are exploded in situ and increase soil damage.[18]

Albeit minimally, land degradation may be caused by chemical contamination. Regardless of whether their explosive contents have detonated or not, landmines and ERW contaminate the soil and water sources with toxic substances,[19] including heavy metals[19] and depleted uranium,[7] which come from either the ammunition casings or their explosive contents.[11]

It is worth noting that there is little evidence of actual chemical contamination from conventional mines. There are a few landmines which might use liquid explosives (e.g. PFM-1) that have toxic effects. However, given their small size, the resultant contamination is most likely negligible. The majority of mines are constructed from TNT- and RDX-based explosives, which are largely organic compounds and result in little or no toxic effects.

Notably, the arable lands not contaminated by landmines usually suffer from over-cultivation. First, a smaller portion of land is pressed to produce more to compensate for the contaminated areas.[7] Second, these areas are often occupied by forcibly displaced persons, who perceive the settlement as temporary and do not invest in sustainable land management.[20] In the long term, these practices may lead to soil exhaustion and decreased food production.

Landmines also contribute to a reduced rural workforce by killing, maiming, or injuring thousands of civilians every

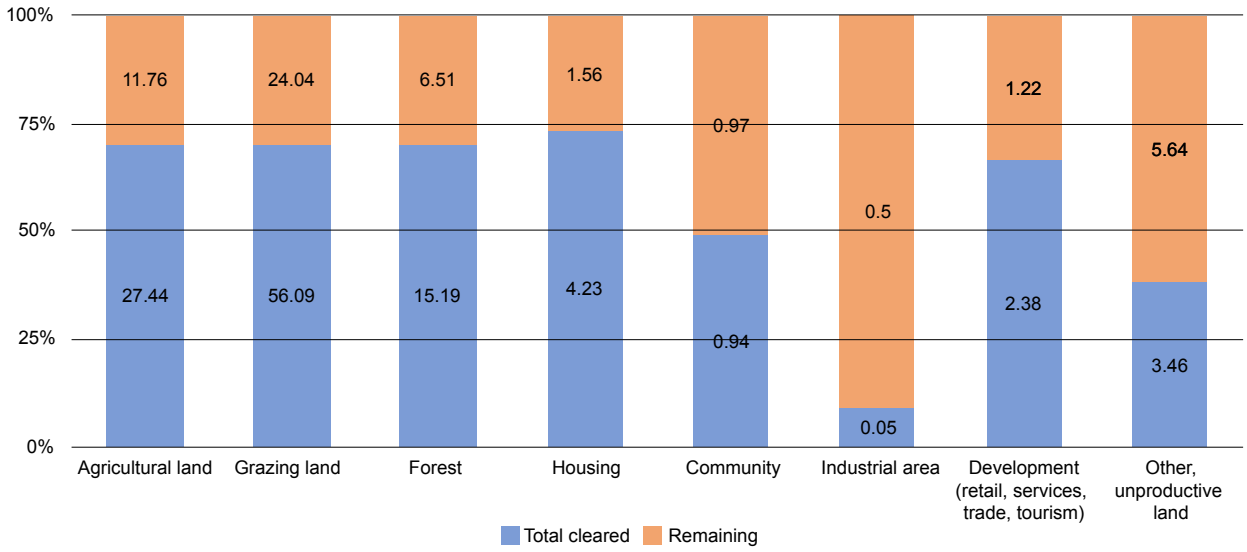

Figure 2. Estimation of contaminated land distribution in square kilometers (as of 2017).[30]

year. Mostly men and boys, who are usually the ones responsible for providing for the household, fall victim to landmines and ERW.[10]

Finally, mine action entails considerable costs to the affected state, posing as a financial burden to investments in development. The already fragile economies of affected countries are further weighed down by the enormous costs of mine clearance and victim assistance.[7,9] Therefore, international support is critical for sustaining mine action programs. However, when badly managed, food assistance may undermine local production and cause aid dependency.[22,23]

Case Study: Lebanon

Lebanon is mostly contaminated with landmines and ERW from its two most recent conflicts: the Lebanese Civil War (1975–1990) and the 2006 Israel-Hezbollah Conflict, as well as minor clashes with Israeli forces from the 1990s to the 2000s.[24,25] A survey conducted in 2003 estimated that a total surface of 279.4 sq km was suspected to be contaminated with landmines from the civil war.[25] The last contamination occurred during the Israeli bombings from July to August 2006, when an additional 54.9 sq km were contaminated with approximately one-million cluster munitions that did not detonate.[26,27] In northeast Lebanon, spillovers from the current conflict in neighboring Syria has also led to new contamination of mostly IEDs, booby-traps, and unexploded ordnance (UXO).[28]

It is estimated that landmine and ERW contamination in Lebanon after the 2006 invasion reached a peak of about 334 sq km, more than 3.2 percent of the country area.[26] The most affected areas by landmines are in Batroun, Chouf, Jbeil, and Jezzine, north of the Litani river, in the Bekaa Valley, and across Mount Lebanon, as well as the Blue Line, the U.N.-demarcated border with Israel.[24] Cluster munition contamination is concentrated in southern Lebanon, south of the Litani river.[29] A recent study commissioned by the United Nations Development Fund and LMAC further estimated the distribution of the contaminated area according to their use (Figure 2).[30]

Even though most of the affected areas are comprised of agricultural and grazing lands, those areas were defined by the Lebanon Mine Action Authority as second priority, and the clearance processes began only in 2009. The first-priority areas include access roads, infrastructure, water, electricity, municipalities, schools, houses, and gardens; while the third priority consists of uncultivated land, natural reserves, and wildlife territories.

Socioeconomic development has been considerably affected, especially by ERW contamination. Almost 40 percent of land used for livelihood has been contaminated and, out of the total area contaminated with cluster munitions, 97 percent is used for food production (78 percent for crop cultivation and 19 percent for livestock).[29] Apart from major losses in the 2006 harvest season, unexploded cluster munitions rendered a large swath of southern Lebanon inaccessible to the local population.[31,32] LMAC estimated that the cost of lost agricultural production in 2007 amounted to US$126.7 million. Due to the mine action program, this value dropped to $25 million in 2011.[24] Darwish et al., however, argue that estimates of economic losses in southern Lebanon usually fail to account for indirect costs, which could amount to four times the initial estimates.[33,34]

Post-conflict reconstruction and rehabilitation, as well as development of infrastructure, were considerably hindered by landmines and ERW in southern Lebanon.[35,36] Preliminary estimates of the damaged caused by the 2006

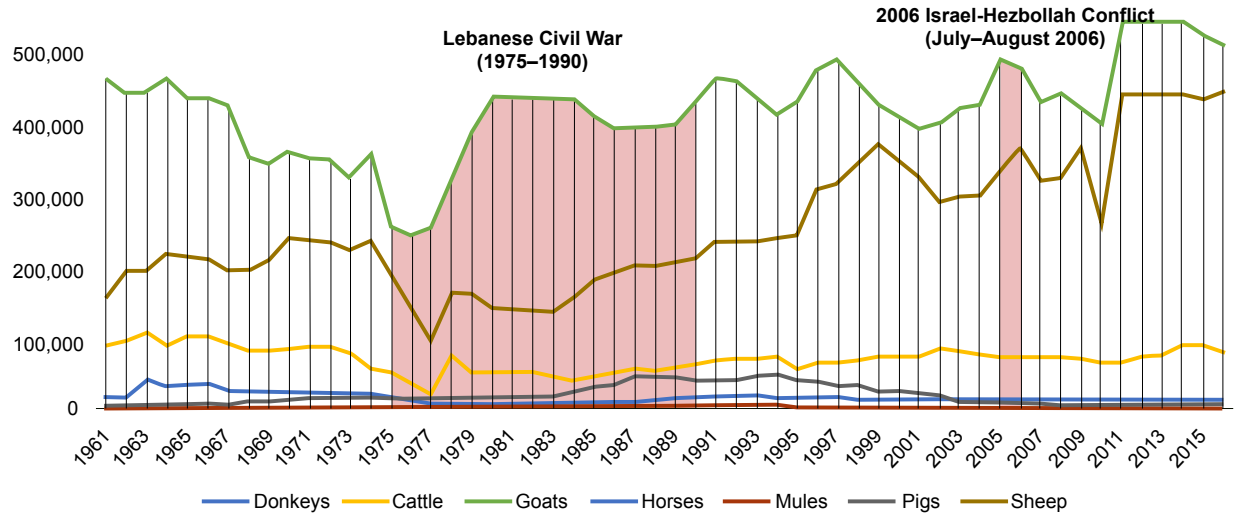

Figure 3. Number of livestock in Lebanon 1961–2016).

war accounted for more than 340 infrastructure locations and sections of road rendered inaccessible.[37] Accordingly, infrastructure was prioritized by the national mine action strategy for land release and was completely cleared between 2006 and 2009.[24,38]

There is not much research on the impacts of landmines and ERW on land degradation in Lebanon. In terms of biodiversity, however, natural reserves and wildlife territories were defined as third priority and have only recently been targeted by mine action programs.[30,37] In addition, landmines are known to have impacted the management of cedar forests, in particular the Tannourine Cedar Forest Nature Reserve.[39]

Mine clearance also contributes to the loss of biodiversity and micro-relief disruption in Lebanon. Mined areas are burned prior to demining in order to remove vegetation and facilitate mine clearance operations. This practice has been employed since at least the 1990s[40] and has become a standardized practice, as provided for in the National Mine Action Standards (NMAS).[42] In accordance with regular manual demining techniques, ground vegetation is removed during mine clearance operations. However, the NMAS do not specify the maximum branch diameter to be cut and removed,[40] leaving it to the discretion of demining organizations. Moreover, the default disposal procedure for landmines and ERW is destruction in situ. This means that wherever found, landmines and ERW shall be destroyed, except if it proves to be impractical or poses considerable risk to nearby structures.[40]

Literature is mostly absent in addressing soil and water contamination due to landmines and ERW in Lebanon. Nonetheless, there is strong evidence of depleted uranium contamination from Israeli bombings in 2006.[42] This contamination is likely to come from bunker busting bombs and missiles, which are less likely to fail and become ERW. Moreover, other general studies on soil contamination in

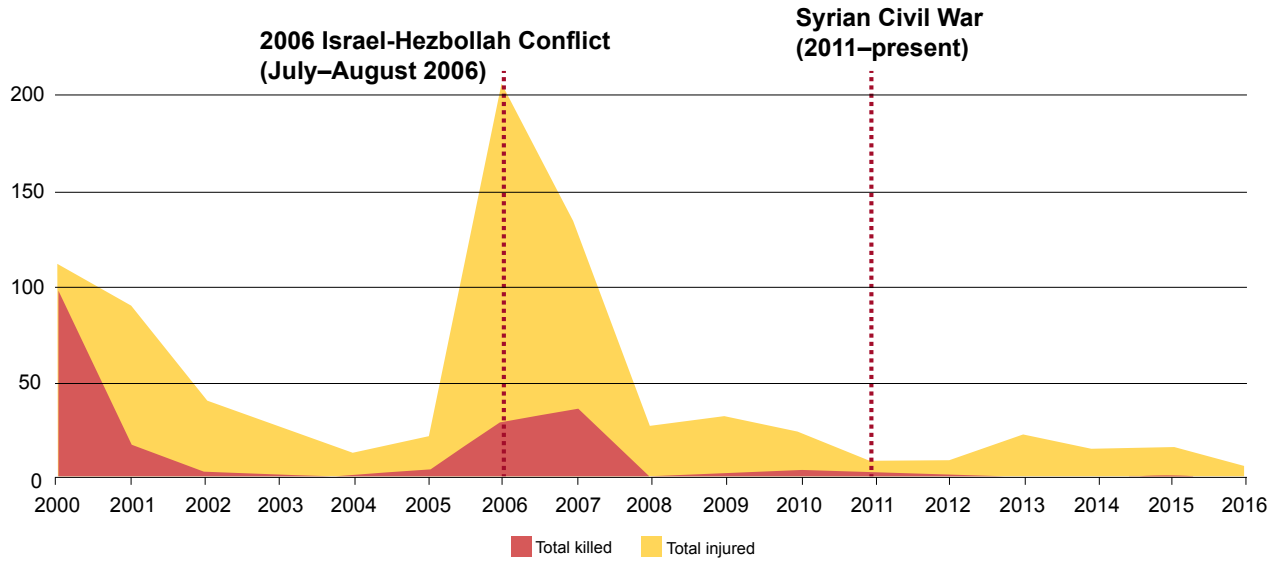

Figure 4. Total landmine and ERW casualties (2000–2016).

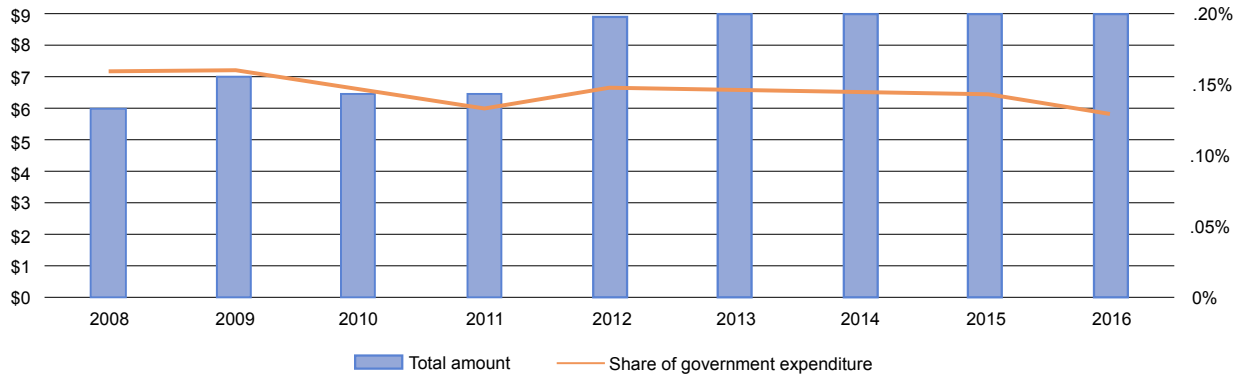

Figure 5. National investment in mine action, in million US dollars and as share of total government expenditure.

Lebanon do not consider landmines and ERW but focus on other sources of pollution.[43]

Loss of livestock is not accounted for in national or international mine action reports,[44,45] as it does not seem to present a grave problem in Lebanon. Accordingly, data from the Food and Agriculture Organization (FAO)[46] suggests that livestock production is more conditioned to the conflict itself and area access than the physical effects of landmines and ERW (Figure 3).

As of the end of 2016, at least 3,736 people were involved in accidents with landmines or ERW, of which 906 were killed and 2,830 injured.[47] Even though the data available on casualties is highly inconsistent, most sources indicate that victims are largely men and boys—accounting for roughly 90 percent of all casualties—from rural communities.[48] After the Israeli invasion in 2006, casualties were concentrated in southern Lebanon; however, due to the influx of Syrian refugees since 2011, victims are now concentrated in the northern and eastern regions.[47] Accordingly, data made available in reports from the *Landmine and Cluster Munition Monitor* and LMAC [25,43,46,49-61] show a sharp increase in casualties after 2006 and a smaller increase after 2011 (Figure 4). The graph also suggests the beneficial outcomes of mine clearance and mine risk education (MRE), since casualties tend to decrease in time.

By design, most mine-related incidents do not cause death. Likewise, the desired effect of cluster munitions is achieved by their detonation in large quantities; individually, one munition is usually not sufficient to kill a person. Accordingly, Youssef and Jawad Fares have found that most casualties in Lebanon suffered amputations and injuries in craniofacial regions, thorax, abdomen, and lower and upper extremities.[62] Those injuries led to loss of motor function, body disfiguration, chronic pain, and post-traumatic stress disorder.[60]

The Government of Lebanon, as indicated in Figures 5, 6, and 7,[44,63] has invested $7.88 million per year on average in mine action for the last ten years, or roughly 13 percent of total government expenditure (Figure 5). In comparison to international mine action funding, even though more modest on average, national investments are more stable (Figure 6). Moreover, the national share of mine action funding has considerably increased since 2008 (Figure 7).

Even though Lebanon is a considerably well-structured and functioning state, information on landmines and ERW is often inconsistent, missing key observations, and scattered across various sources, perhaps due to the recent establishment of the national authority and coordination center.[64]

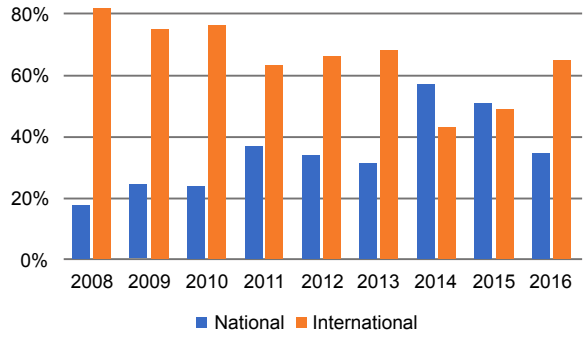

Figure 6. National and international investment in mine action, in million US dollars.

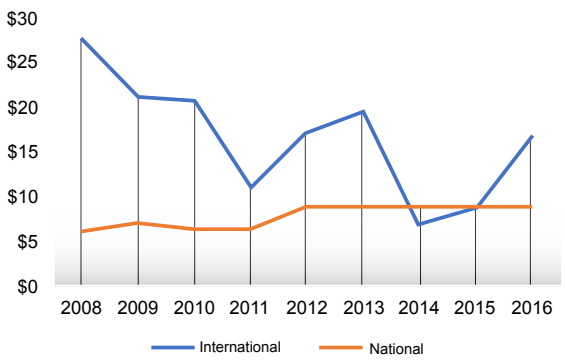

Figure 7. Share of total investments in mine action.

Discussion

As previously discussed, Lebanon has been significantly affected by the scourge of landmines and ERW. Contaminated areas have denied access to large swaths of arable land, especially in southern Lebanon, and, to a lesser extent, to water sources and infrastructure. According to LMAC, all water sources and infrastructure are deemed to be clear from mines and ERW. Indirect losses in productivity due to lack of access to arable land and pasture may amount to about $30–$60 million, during an estimated ten-year period for clearing the affected areas.[33]

Victims of landmine and ERW accidents undoubtedly suffer tremendous personal challenges. However, the total number of casualties is likely too small to impact food production and food security outside the victim's closest circles. It is worth noting that the number of casualties has considerably dropped in recent years, probably due to the ongoing MRE and mine clearance activities.[44] That said, food security is perhaps more affected by the displacement of rural workers toward urban environments as a consequence of lack of access to arable land and fear of the threat of landmines than by the direct effect of landmines in killing or maiming civilians.

The recent influx of Syrian refugees coupled with the existing mine and ERW threat pose yet another risk to food security in Lebanon. Refugees are concentrated in mostly mine- and ERW-free areas in the Bekaa Valley,[29] which is also the region with the most productive agriculture and livestock in Lebanon. In 2015, an estimated 3.3 million people, including Syrian and Palestinian refugees and host communities, were in need in the country; of which 1.35 million were in need of food.[65] Food aid is mainly provided by the World Food Programme and its partners, mostly through e-cards, cash, and food vouchers.[65] These measures help foster local economy and build local capacities, avoiding aid dependency. However, as proposed by Berhe[7] and in reference to Hardin's tragedy of commons,[21] it is likely that the concentration of refugees in small areas will lead to over-cultivation and soil exhaustion in the long run unless accompanied by efficient water and land management.

Despite considerable international financial support, the Government of Lebanon bears significant costs for its mine action program. In the last years, almost .15 percent of government expenditure have been dedicated to mine and ERW clearance, MRE, victim assistance, and other support and administrative costs. Nearly all the investment goes to mine clearance, which is the most expensive component of mine action. In 2016, for example, about 93 percent of total investments was dedicated to the clearance of landmines and ERW.[44] The financial burden born by the Government of Lebanon is an impediment for investment in other areas, such as infrastructure, agriculture, and water and land management. On the other hand, the Lebanese mine action program is consistently becoming less reliant on international support, thus decreasing its risk of aid dependency.

Conclusion

Access denial, especially to arable land and pasture, and the financial burden born by the government seem to be the most pressing challenges to food production in Lebanon. Lack of access is not only the main cause of insufficient agricultural productivity, but it is also responsible for channeling the movement of Syrian refugees and restricting settlements. Even though there is not enough information on land degradation in relation to landmine and ERW contamination, it is best contained with effective water and soil management techniques and programs. The economic costs posed by the mine action program, however, consist of a significant share of government expenditure and arguably presents an impediment to investments in other areas.

However tragic, the reduction of rural workforce due to mine- and ERW-related incidents does not seem to be sufficient to impact large-scale food production and food security. Mine victims and their families certainly face huge challenges to rehabilitation and personal development, but this impact is likely to be restricted. Likewise, the loss of livestock does not appear to be a significant concern.

Finally, there may be significant information gaps and measurement errors in the data on mine action in Lebanon. On top of that, the psychological impact and trauma caused by death and injury of loved ones, being unable to provide for your family, the loss of livelihood activities, and the constant fear of landmines, are harder to measure.[34] However, they certainly have profound effects on the economic, social, and psychological well-being of local communities.

See endnotes page 61

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