GLOBSEC
IDEAS SHAPING THE WORLD

Cleaning the Augean Stables: Humanitarian Demining in Ukraine

www.globsec.org

Authors:

Iuliia Osmolovska, Director, GLOBSEC Kyiv Office

Nataliia Bilyk, GLOBSEC Kyiv Office

Ukraine and Eastern Europe Programme

A more in-depth analysis of the data has been prepared by the Ukraine and Eastern Europe Programme.
Go to **www.globsec.org** to find out more.

CONTENT

EXECUTIVE SUMMARY

1. There is no example in the world that humanitarian demining (HD) has ever been conducted in a country with ongoing international armed conflict of high intensity where the full spectrum of conventional weapons has been being used. The situation in Ukraine is much more aggravated as the whole territory cannot be considered safe and cleared from unexploded ordnance (UXO) until Russia continues to strike Ukraine with missiles and aviation bombs. No part of Ukrainian land can get an internationally recognized status of a cleared territory from explosive ordnance (EO) until Russia stops shelling. In times of ongoing war and threat to the entire territory, a form of a 'provisional' HD should be foreseen instead, which could enable Ukraine to apply the norms of HD under circumstances when it is impossible to conduct a 'classic' one. It would be also useful to envisage a system of periodical or ad-hoc checking of cleared territories after air strikes if a zone was attacked by missiles, as well as to align it with a system of rapid response and control by competent authorities.

2. In the **Mine Action Review 2023,** Ukraine was put in the highest category of contaminated countries in the world, with the classification of its level of contamination as 'unknown, but massive'. Nevertheless, the well-known number of 174,000 sq km of potentially contaminated territory of Ukraine had been reduced by 18,000 sq km by the end of 2023 as a result of a non-technical survey (NTS) and respective cancellation of these territories. The assessed potential contamination currently applies to **156,000 sq km**. It is important to conduct intense work on NTS to cancel as much land as possible and to come up with more realistic figures of suspected hazardous areas (SHA) and confirmed hazardous areas (CHA) in Ukraine. The Government of Ukraine **expects** that around 5-10% of all potentially contaminated land (around 13,000 sq km) might require technical survey (TS) and about 2-8% (about 9000 sq km) might require clearance from mines and EO.

3. For the time being, there are 45,000 sq km available in Ukraine for HD works. The Government is **ambitious** to clear and release 80% of the contaminated territories in the aforementioned areas in the next 10 years. Some experts confirm that this is feasible provided there will be at least 10,000 deminers, a sufficient number of machines and robotic systems, as well as surveillance, detection and extraction drones.

4. The general population of Ukraine still remains largely ignorant of the danger of EO, which is reflected in high numbers of incidents. Therefore, it is imperative to continue with demining and explosive ordnance risk education (EORE) for the population of Ukraine. Otherwise, the number of accidents from EO might rise to 9000 cases by 2030. Apart from general ignorance of EO risks, people (mostly, farmers) had been desperately striving to resume their household activities as soon as possible, sometimes by ignoring security concerns.

5. The main economic sector, which is affected by contaminated land, is agriculture. Around 8 mln ha of fields is filled with explosive remnants of war (ERW), with 6 mln ha being on the temporarily occupied territories and 2 mln ha — on the liberated ones. Farmers are losing 930 USD per hectare with costs for full clearance, and land release amounting to another 1781 USD per hectare. Annual loss of potential profits due to ERW-contaminated territory will reach 800 mln USD annually. Crops grown on potentially contaminated territories enabled to feed around 81 million people globally. It is imperative to resume economic activity in the agricultural sector of Ukraine as soon as possible. By mid-December 2023 there had been **268,500 ha** surveyed (over 50% of those planned for 4 years) with 205,000 ha released for further exploitation.

6. Getting land cleared and released for further use will not be enough. An initial special assessment of soil contamination should be made. Resuming agricultural activity without proper assessment of the quality of soil could lead to the production of lower-quality goods, and Ukraine might run a risk of losing its place in world markets of agricultural products.

7. The emerging challenge of land restoration is another elephant in the room alongside demining itself for the same reasons: scale, size and intensity of contamination. Ukraine needs to plan actions for the identification and categorisation of territories subject to conservation, decontamination (from particular pollutants), re-profiling of its usage or immediate release.

This will also save time for demining works on territories suitable for conservation only. Restoration of the land will be no less (and in some cases even more) costly than a demining itself. Ukraine and its international partners should already plan ahead for this important work, if we want to restore the fertility and quality of 19% of agricultural land in Europe that is located in Ukraine.

8. A huge amount of work for deminers will be related to the disposal of unexploded ordnance, which apart from risks to human safety also poses a serious detrimental impact to the environment and quality of soil. According to the Ukrainian military, in the war Russia uses old ammunition produced over 30 years ago, **40%** of which either does not explode or its explosive substances do not burn out completely and pollute the air. The dud rate of Russian munitions is between **10 and 30 percent**, with cluster munitions reaching **40%**. In 2022 Russia alone fired around **11 million** artillery rounds, which might amount to over 2 million UXO on the territory of Ukraine left from artillery shells in 2022 only.

9. Different types of terrain might require different mine detection tools and, therefore, add to the complexity of demining. Areas like forests and aquatic territories would require specific tools and knowledge to clean the territory from EO. Occupied forestry territories including those along the frontline constitute over 800,000 ha. The movement of heavy military equipment alongside combat actions zones in forests is leading not only to heavy contamination, but also to the destruction of the ecosystem of terrain, soil, and aquatic objects. In the long run, an accumulation of solid wastes, destroyed military equipment and EO will severely affect the environment. The Government of Ukraine is already considering a long-term plan for the restoration of nature conservation areas affected by the war. The strategy will include actions to rehabilitate ruined ecosystems and to create, at least, new 10 contemporary natural parks, 10 rehabilitation centres for wildlife species and to monitor the restoration of biodiversity. All these efforts will definitely require international assistance and support in the mid-term perspective.

10. One of the forthcoming challenges in HD is the contaminated aquatic resources of Ukraine (around **13,500 sq km** altogether and around 7300 sq km in de-occupied territories). With the destruction of the Kakhovska Hydro Electro Power dam in June 2023, a mine and other EOs contamination map has changed shape completely: many shells and mines have surfaced and floated to different places along the flood routes; some of them went onto the Black Sea, some laid at the bottom of the Dnipro River. Demining works on these territories could take around 15 years, as EO is difficult to detect and identify in this mud and extract from dried-out soil. These territories are likely to become new national conservated areas as well.

11. As to the scope of the work of HD in the Black and Azov Seas, a special monitoring operation needs to be undertaken. Yet, it is not safe to conduct it for the time being due to the active presence of Russian aviation in the area. The complex operation to demine the Black and Azov Seas will take around 3-5 years and in 3-5 months it will be possible to demine the main naval routes.

12. Developments since April 2023 have demonstrated a vigorous rise in staff and trained personnel as deminers. Most of the progress had been observed within state-certified operators, some of it within international NGOs operating in Ukraine and less with Ukrainian non-state actors. Overall plans for 2024 anticipate almost doubling the human resources available, thus, capable of reaching or even exceeding the targeted amount of 10,000 staff by the end of the year.

13. The Government of Ukraine undertakes efforts to speed up the process of certification of the companies/NGOs with the required qualifications, who are willing to work on the market. It has streamlined the procedures and made them simpler. To date, 29 operators have been certified and 44 more organizations (both, international and national) have applied for certification and are expected to receive it in 2024. There are reasonable concerns about the capacity of the existing accredited agencies to cope with amount of the work, without losing the quality of thorough inspection and verification of the necessary qualifications of the applicants. Another concern still remains about certain corrupt practices that could be in place when the human factor is involved. The Government of Ukraine is resolved to continue the improvement of the certification with more digitalisation of procedures to make all those processes transparent and to reduce the potential for the human factor to negatively influence the process.

14. While the Government of Ukraine is still working on formal provisions to improve the gender factor in HD, which is to be reflected in the respective Strategy on Mine Action in Ukraine, there are natural processes in the war-torn

country that bring more and more women to the profession. These are mostly linked to the mobilization and conscription of the male population to the Armed Forces of Ukraine, high demand for deminers and rather attractive salaries, which range from 17,000 to 50,000 UAH in different regions of Ukraine. The average female rate across all the state and non-state operators is around 30%.

15. There is more imperative need to ensure enough training capacities for deminers both in Ukraine and the partner countries. With a view to the growing needs in aquatic demining, there is a potential for littoral partner countries that have a developed school of underwater demining to consider options of offering training services for Ukraine. More emphasis should also be placed upon the training of operators of mechanized demining and MDDs' (Mine Detection Dog) handlers as these segments of HD in Ukraine also show an exponential rise and demand.

16. There are obviously some accompanying challenges that might affect ambitious plans to bring the number of deminers even to the minimum desirable level. Most importantly, it is about enough equipment for personal protection and deminer kits. Thorough calculations should be made to match the number of existing (and future) staff with the equipment available (and potentially received) to use resources most optimally. Perhaps, it would make sense to create fewer demining and EOD teams and train them based on expected assistance to receive donated equipment.

17. The progress in obtaining different machines and equipment for mechanized demining in Ukraine in 2023 is impressive, starting from 12 in March 2023 to almost 60 by December 2023. The major donors of equipment were Japan, Canada, Korea, Switzerland, Lithuania, the Howard G. Buffett Foundation, the Estonian Rescue Association, UNDP and others. The need for this type of HD tool is obvious, as it helps to improve the safety and speed of demining. Yet, unprecedented use by the enemy of air bombs, rockets, munition of larger calibres, and vastly scattered sub-munition mixed with different types of mines and improvised explosive devices (IEDs) cause a lot of problems for mechanical demining teams, thus, reducing the clearance pace if compared to the one demonstrated during official equipment tests or demining of standard minefields.

18. The noticeable 'fashion' for mechanized demining machines that all Ukrainian operators are seeking, should be strictly adjusted to specific tasks and areas where operators work. All of the requests should be verified accordingly, otherwise, it will be an inefficient allocation of scarce financial resources available for demining.

19. Naturally, high demand for demining machines and robotic systems has created a respective surge in interest by world manufacturers to provide Ukraine with their products. Yet, factors like availability of machines supplied to Ukraine, capacity of producers to manufacture demining machines per quarter, time of delivery, spare parts and consumables (SPC) packages, service and maintenance, existence of repair facilities in geographical proximity to Ukraine, local support teams and partners, regular scrutiny of working conditions of the supplied machines, etc — should be duly considered before selecting an original equipment manufacturer (OEM). OEMs should also be allowed to make their production plans for Ukraine's needs far ahead, as many of them are dependent on assembly parts supplies from other producers. More advanced government planning and clear target setting as to the number of machines of a specific type, source of finance (state budget of Ukraine, private donations or international donor pledges) and centralized indication of end-users among the state operators seems to be highly advisable.

20. The Government of Ukraine is encouraging local manufacturers to consider ways of developing their production of demining machines, to set up joint ventures and/or to get engaged in other forms of cooperation with international OEMs to boost supply on the market. The benefits of this approach are obvious as it enables the revival of SME activity, creates new jobs, integrates into international supply chains, provides more taxes to the budget and minimizes geographical proximity to end users. This focus on reinforced manufacturing in Ukraine is also strategically justifiable, as, in perspective, this could lay the foundations for a revival of the heavy engineering industry. Among the main challenges, the Government defines a lack of proper manufacturing capacities in Ukraine to produce machines and assembly parts, as well as less advanced technologies, so the option of ordering equipment from abroad still remains very attractive.

21. There are a number of Ukrainian manufacturers who try to produce demining machines themselves. To improve the quality and technological capacity of these machines, local producers import a lot of assembly parts from abroad. Considering a temporary VAT

and customs duties' exemption for imported assembly parts (materials, technical units, sub-units, equipment and components) that are imported by manufacturing companies to produce/repair demining machines is seen to be a good incentive to boost the development of local production.

22. The current period is being characterized by a splash of different initiatives of the private sector, and IT start-ups to invent the most efficient technologies for demining and to apply them in Ukraine. The Government of Ukraine encourages these efforts and supports them. At the same time, a cautious approach should be taken when it comes to testing, as the rules on the use of products/technologies, quality control and qualification are of utmost importance and should be conducted within a proper set of internationally recognized standards. No prototypes invented locally such as tractors/machines with adjacent IT technologies/use of drones with no global international activity records should be easily qualified in UA, otherwise, it can get challenging to guarantee the quality of the work of HD.

23. The establishment of the competitive market for humanitarian demining was defined as of one the priorities by the Government of Ukraine. The solution is seen in the vigorous development of service purchases through price reduction auctions, where both national and international operators can participate. The aim that is set is to help small farmers get these services at fair prices through competition from certified operators. Helping a farmer to receive such a service would potentially mitigate the problem of 'dark deminers'.

24. Given the surge of many new civil society groups, NGOs, trade unions, charitable foundations and organizations with a focus on humanitarian demining, this issue has definitely become a 'fashion' in Ukraine. There are as many as 21 different groups and non-profit organizations, with 13 of them created in 2023 alone. Whilst welcoming the engagement of different civil society groups into discussions on humanitarian demining, there should be particular scrutiny concerning the track records of these organizations and the qualifications of their personnel.

25. Effective information management will be a key challenge in the effort to realise operational outcomes from innovative processes. It is essential for decision-makers at every level to have access to clear and coherent data to build a complete picture of the risks and land use. It will be the ability to combine potential risk (what is the likelihood of a hazard being present?), with opportunity cost (what is this land being used for?) that will establish priority. This must broaden the remit of existing information management systems, those that are built for specific processes and standards. Ukraine will need to combine vast data sources across government, public, private, and commercial sectors. Beyond simple data collection, this asset must be effectively and continuously analysed to adequately prioritise demining operations and manage risks. The results of such analysis must form an operational part of the coordination of operators. It is important that any system introduced remains compatible with existing standards and is simple enough to be used by operators of all technical abilities. Furthermore, any such system should come with strict guidance on data governance requirements such that information is shared on a need-to-know basis.

26. Over 2023 experience proved that the existence of multiple governmental bodies on HD in Ukraine with almost similar tasks could be organized in a rather collaborative manner. Despite some remaining confusion — especially, among international partners — about 'who is responsible for what?' it seems clear that communication channels have been streamlined and are working well.

27. It has been acknowledged by the Government of Ukraine that the existing regulatory base requires substantial improvement. In 2024 this review should lead to further simplification of the certification procedures and making them digital. Other initiatives include proposals to amend the existing Mine Action Law, upgrade standardization procedures to include streamlined certification of operators, and procedures, introduce standards for mechanized demining and other tools (MDDs, remote survey), a harmonized system of training aligned with those existing in partner countries and many more.

28. One of the existing challenges is to make the process of needs assessments, requests and donor commitments more aligned and visible, as previous practice enabled different state operators to reach donors directly and to ask for assistance to meet specific needs. The Government is still struggling to see the whole picture of needs/requests-commitments/pledges and to adjust it where required. It would greatly help to make a full and comprehensive inventory of full needs/requests-commitments/pledges that have been submitted by individual state operators

to donors directly. Consideration should also be given to another backchannel at the political level within the governments of partner countries to speed decision-making within the newly established sectoral working group on HD under Ukraine, UNDP and Japan as co-chairs.

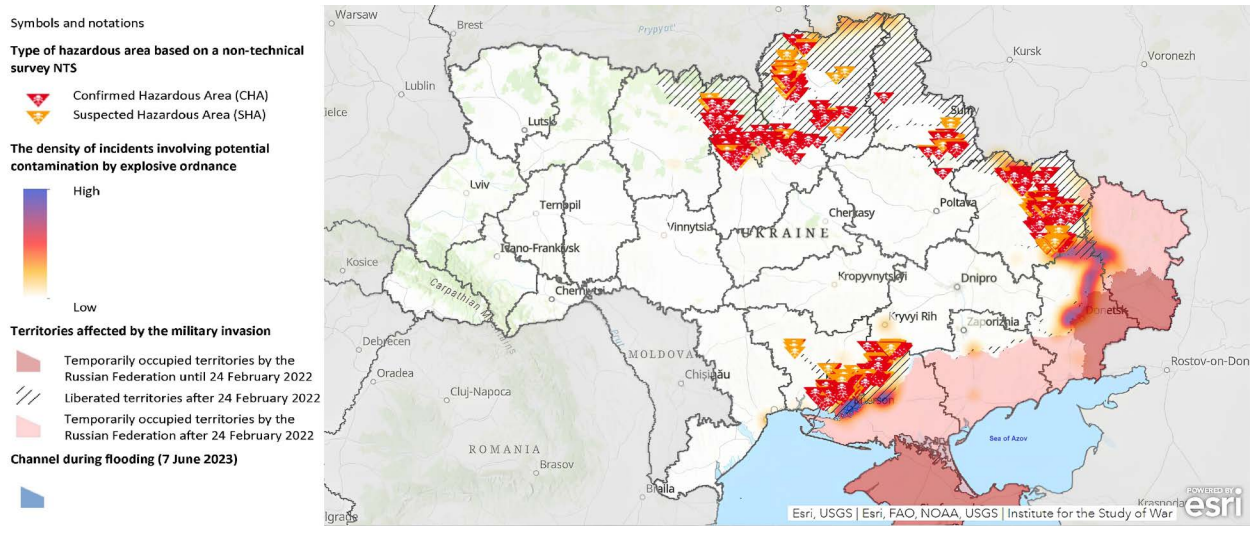
29. Over 2023 activities of international partners were substantially solidified, which demonstrated the resolution of the consolidated international community to help Ukraine comprehensively tackle humanitarian demining. An **initiative** by the Lithuanian Government to establish a demining coalition among the partner countries for Ukraine is seen as a potentially important and influential mechanism to support the HD activities of the international donor community. Joint efforts of NATO Black Sea littoral states of Romania, Bulgaria and Turkey to form a **Mine-Sweeping Force** to Clear the Black Sea Route are also seen as having the potential for cooperation with Ukraine.

MAIN FINDINGS

This report is a logical follow-on from the two previous GLOBSEC reports on humanitarian demining (HD) in Ukraine, the public version produced in April 2023 and a confidential edition produced at the request of the Ukrainian government in June 2023. We are pleased to note that the report ***Walking on Fire: Humanitarian Demining in Ukraine*** received a great deal of international publicity, being quoted, inter alia, by **Euronews**, **EURACTIV**, DW, LRT, the Washington Post, TIMES and others. Most of this publicity came out of striking figures that GLOBSEC calculated for demining — 757 years with the resources available, and provided all the potentially contaminated territory of 174,000 sq km IS actually contaminated. For these figures, we have also received criticism that we should not frighten the world with exaggerated figures, but provide more realistic assessments. We still stand by the position that our projections were correct, based as they were on official figures concerning the pace of demining works, the number of specialists engaged and the assumption that all 1/3 of the territory of Ukraine is contaminated with mines and other explosive remnants of war (ERW).

The aim of the first report was to deliver a first wake-up call to the scale of the problem and the urgent need to seek solutions with the assistance of the international community. We are confident that we managed to achieve this task and contributed to the efforts of the government of Ukraine to work together with international partners on problem-solving: (1) Ukraine has been seeing more in-kind assistance from partners to supply tools and kits for demining; (2) financial commitments for demining have risen almost six-fold since April 2023; (3) human resources (potentially) available for manual demining in 2023/2024 have increased by 50% at an average; (4) number of machines/robotic systems for mechanized demining had increased four-fould by the end of 2023; (5) there is an expansion of other methods of demining — like the use of mine-detection dogs (MDDs), which was not wide-spread in Ukraine before — and under-water demining; (6) more training schools have been emerging; (7) the number of operators in mine action in Ukraine (both Ukrainian state and non-state actors, as well as international non-profit organizations) has almost doubled by end of 2023; (8) the international community has become more consolidated around the topic and is working with Ukraine in multiple formats; (9) the Government of Ukraine has shown remarkable leadership in the process of setting up a proper eco-system of mine action at the national level with a number of initiatives and processes launched ranging from mid-term Strategy on Humanitarian Demining (HD), coordination networks (both, horizontal and vertical) localized production of machines/robotic systems to high-tech innovations and artificial intelligence (AI) for HD. We can confidently say that the mine action in Ukraine and HD as a key part of it has become a crucial chain in the DNA of the reconstruction in Ukraine. Needless to say, these efforts are undertaken against an ongoing war and constant missile attacks and shelling that significantly challenge the whole demining process and continue putting at risk the lives of all those in Ukraine.

With the current report, we want to show this increase in developments outlined above and to measure, where possible, the progress throughout 2023 that has been made through the collective efforts of the



Source: adapted from **ua.imsma.org**

Demining of Ukraine

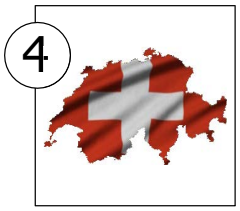
During the full-scale war, Ukraine became the most mined country in the world.

30%

of Ukraine's territory needs to be inspected for mines.

This can be compared with:

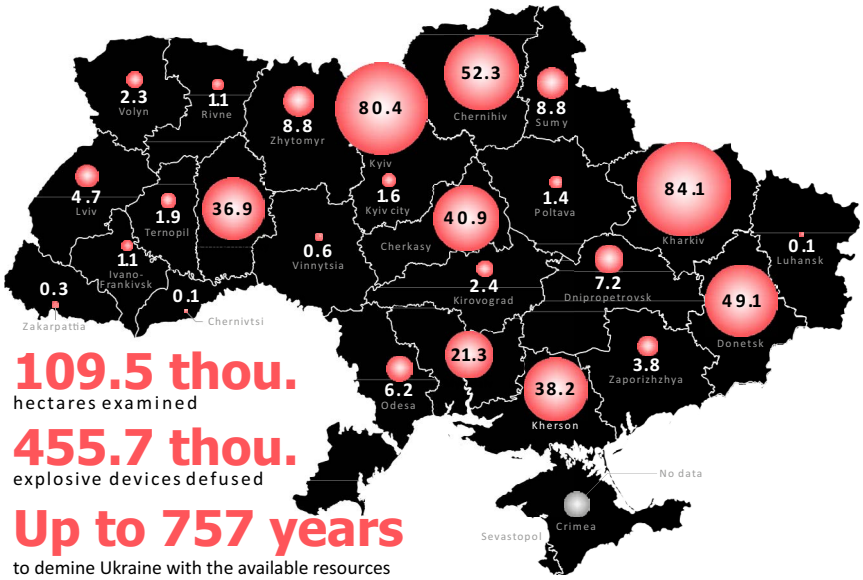
United Arab Emirates



Switzerland

Demining takes place daily

Explosive ordnance disposal during the full-scale war*, by region, thou. units



109.5 thou.
hectares examined

455.7 thou.
explosive devices defused

Up to 757 years
to demine Ukraine with the available resources

*February 24, 2022 – November 16, 2023

Source: Top Lead Survey, November 2023, GLOBSEC calculations from Walking on Fire: Demining in Ukraine report

Ukrainian government, partner countries and institutions, state and non-state actors, responsible expert community and civil society. With this analysis, we shall also highlight remaining and emerging challenges in mine action and humanitarian demining in Ukraine, which have been identified in 2023, and come up with viable policy recommendations for both Ukrainian and international policy-makers.

I. MAKING CORRECT ASSESSMENTS: NOT TO FRIGHTEN, BUT TO WARN

According to the Ministry of Defence of Ukraine (MOD), territories where combat actions have taken place those within the active zone of hostilities, those under temporary occupation and those under aviation and missile attacks are considered as **potentially contaminated**. According to this definition, and given the non-discriminative nature of continued missile strikes by Russia ALL OVER Ukraine, its entire territory should be considered as potentially contaminated and would require thorough examination.

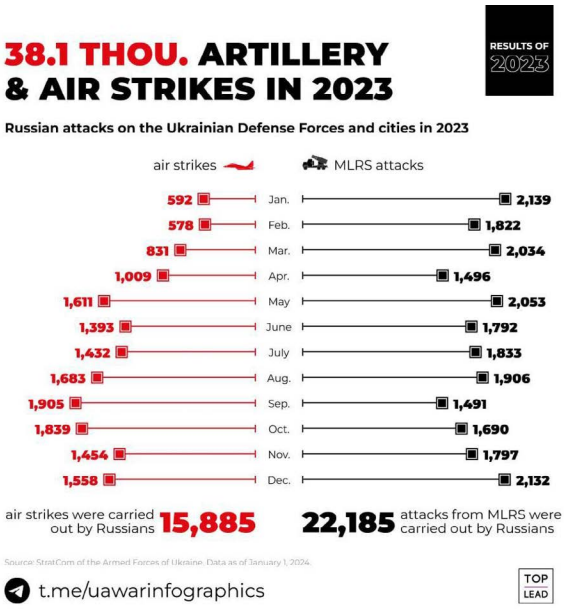
In times of ongoing war and threat to the entire territory of Ukraine, it is difficult to conduct a 'classic version' of **humanitarian demining**, which, according to **The Practical Guide to Humanitarian Law**:

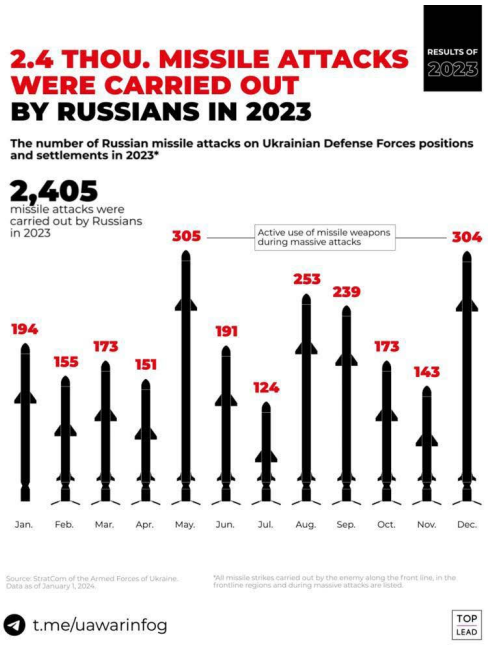
'only applies to activities carried out immediately following the cessation of hostilities. Although in recent conflicts it has become increasingly difficult to determine exactly when the conflict is over, the signing of a cease-fire or peace accords is often used as a point from which to begin demining operations. These operations are important to favour the return of displaced populations or to facilitate the organization of elections.

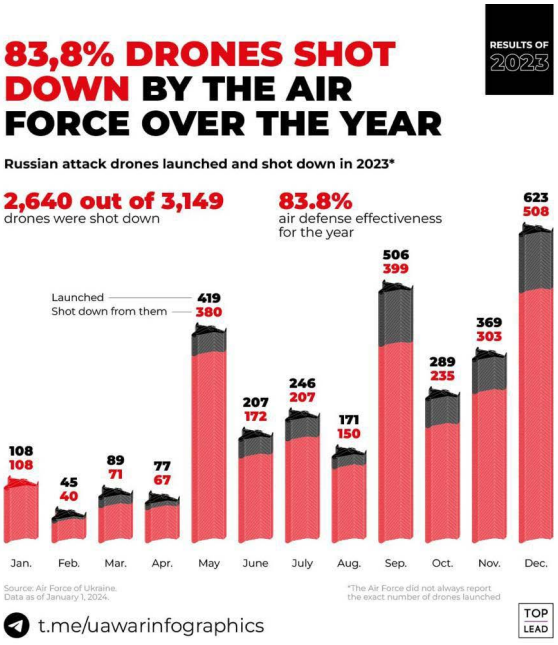
During a conflict, demining can be combined with humanitarian relief operations. However, such activities must be undertaken very carefully because they can be seen as a military threat and result in reprisals against humanitarian actors.'

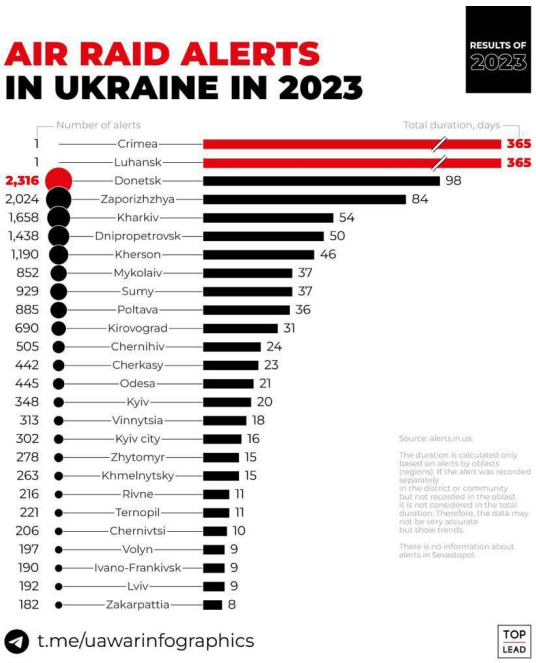
There is no example in the world — to the best knowledge of our expert team — that humanitarian demining has ever been conducted in a country with ongoing international armed conflict of high intensity where the full spectrum of conventional weapons has been being used. The situation in Ukraine is much more aggravated as the whole territory cannot be considered safe and cleared from unexploded ordnance (UXO) until Russia continues to strike Ukraine with missiles and aviation bombs. Ukraine does not have any region that might be classically considered as cleared, while Russia continues with missile strikes. No part of Ukrainian land can get an internationally recognized status of a cleared territory from explosive ordnance (EO) until Russia stops shelling.

These considerations might become particularly valid given the dud rate of Russian ammunition (see









respective section of the Report), as well as **plans** of Russians to equip their Kh-32 missiles with cluster munitions.

Therefore, we can claim that in classical terms **Ukraine does not have the necessary pre-conditions for humanitarian demining.** We should more accurately talk about a form of a 'provisional' humanitarian demining which could enable Ukraine to apply the norms of humanitarian demining under circumstances when it is impossible to conduct 'classic' humanitarian demining. It would be also useful to envisage a system of periodical or ad-hoc checking of cleared territories after each air strike if a zone was attacked by missiles, as well as to align it with a system of rapid response and control by competent authorities.

In the **Mine Action Review 2023,** Ukraine was put in the highest category of contaminated countries in the world, with the classification of its level of contamination as 'unknown, but massive'. Nevertheless, the now well-known number of 174,000 sq km of potentially contaminated territory of Ukraine had been reduced by 18,000 sq km by the end of 2023 as a result of a non-technical survey (NTS) and respective cancellation of these territories. The assessed potential contamination currently constitutes **156,000 sq km** with 13,500 sq km of it being an aquatory.

Both international donors and Ukrainian officials believe that it is important to conduct intense work on NTS to cancel as much land as possible and to come up with more realistic figures of suspected

hazardous areas (SHA) and confirmed hazardous areas (CHA) in Ukraine. Judging from international experience they are confident that the overall size of SHA/CHA will be no bigger than **15-20%**, which is 31,200 sq km.

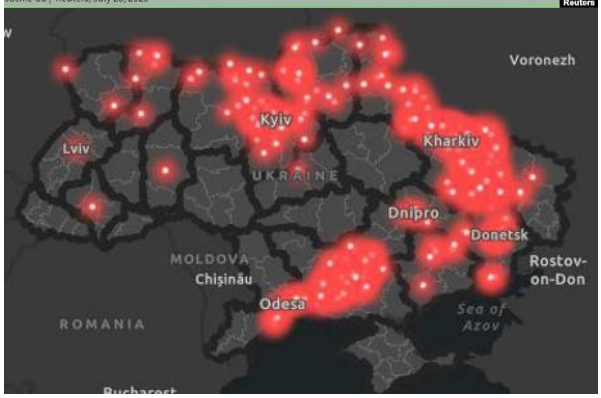
According to official estimates[1], for the time being, there are 45,000 sq km available in Ukraine for HD works. These are territories that lie at 20 km distance from UA borders with Belarus and Russia and at 30km distance from the frontline in Kharkiv, Chernihiv, Sumy, Kyiv regions, as well as parts of Zaporizhzhia, Kherson and Mykolaiv regions. The Government of Ukraine **expects** that around 5-10% of potentially contaminated land (around 13,000 sq km) might require technical survey (TS) and about 2-8% (about 9000 sq km) might require clearance from mines and EO. With these calculations, the Government is **ambitious** to clear and release 80% of the contaminated territories in the aforementioned areas in the next 10 years. Some experts confirm that this is feasible provided there will be at least 10,000 deminers, a sufficient number of machines and robotic systems, as well as surveillance, detection and extraction drones.

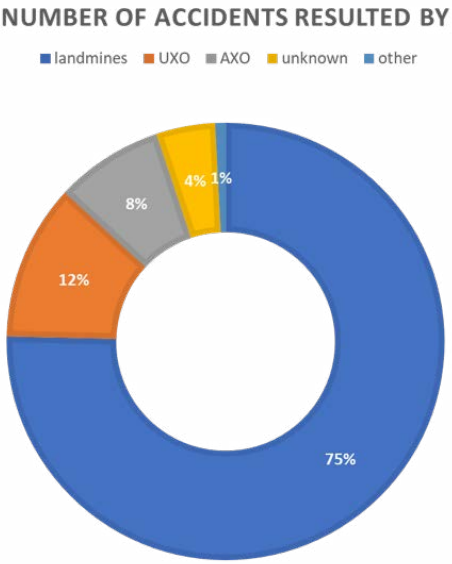
Naturally, the exact size of the contaminated land can be verified only after hostilities are over and Ukraine regains control over its territory in internationally recognized borders of 1991. Until then we can make only very approximate projections. However, challenges other than the very size and scale of contamination can already be observed and anticipated.

II. HUMAN SAFETY — ENHANCING RISK EDUCATION

Despite enforced efforts of the Government of Ukraine and numerous demining organizations put into explosive ordnance risk education (EORE), as well as the high risks of mines and other UXOs in the liberated territories, the general population of Ukraine still remains largely ignorant of the danger, which is reflected in high numbers of EO incidents. According to National Mine Action Authority (NMAA) in 2023 there had been **593 incidents** involving 877 civilians (277 were killed and 600 injured). The numbers are quite high with an average of 73 victims of EO every month.

There are about **6 million** people that remain in risk zones. Therefore, it is imperative to continue with demining and Explosive Ordnance Risk Education (EORE) for the population of Ukraine. Otherwise, the number of accidents from EO might rise to 9000 cases by 2030.





Source: National Mine Action Authority

Most of the incidents (over 50%) happened in Mykolaiv, Kherson and Kharkiv regions. Apart from general ignorance of EO risks, people (mostly, farmers) had been desperately striving to resume their household activities as soon as possible, sometimes by ignoring security concerns. After operative demining, when main access to residential areas, critical infrastructure, and roads had been cleared,

[1] Official reply of MOD #220/52/2857 from 16 Nov 2023 to GLOBSEC inquiry.

Damage to Agricultural Land

For more than two years of full-scale war, Ukrainian agricultural lands have been shelled by Russia. Ukrainian farmers suffer financial and physical damage because explosive objects stop agricultural activities in the fields.

Damage from contaminated soils

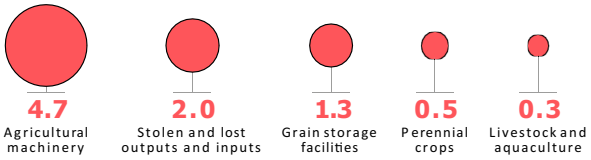
Destroyed equipment and explosives emit heavy metals, TNT, and combustion products.

Rockets, mines, projectiles make it impossible to cultivate, cause fires, destroy crops, and pollute the soil.

During the explosion, harmful substances are released into the air, which subsequently settle on the soil.

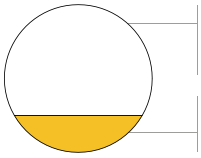
$8.8 bln in losses to agriculture

Agricultural damages due to the war, as of September, 2023, USD bln



8.0 mln ha of fields are mined

The area of mined fields due to the war, as of October, 2023, mln ha



Up to **$800mln**
Ukraine's economy will lose annually from the downtime of these fields

Source: Top Lead Survey, November 2023

people mistakenly thought that the entire land was safe to use. To regain their livelihoods many ordinary Ukrainians resorted to tackling the explosive devices themselves. The techniques ranged from the use of privately purchased metal detectors, agricultural tractors, manual defusing with people's bare hands, and the use of ropes to trigger tripwires. These are extremely risky undertakings made far more deadly due to the lack of laying patterns, and the widespread use of boobytraps and anti-lift devices by Russian forces[2].

III. ECONOMIC IMPACT — RISKS TO GLOBAL FOOD SAFETY

Obviously, the main economic sector, which is affected by contaminated land, is agriculture. According to the Top Lead survey, around 8 mln ha of fields is filled with ERW, with 6 mln ha being on the temporarily occupied territories and 2 mln ha — on the liberated ones. Losses to Ukrainian agriculture have already amounted to 8,7 bln USD. This includes damaged machinery, perennial crops, livestock, aquaculture, lost or stolen products and resources. According to the Kyiv School of Economics' **Agricultural War Damages, Losses and Needs Review**, almost 19% of farming land is contaminated with EO. As of April 2023, overall indirect losses to the agricultural sector caused by the Russian full-scale invasion reached 31,5 bln USD, with 14,3 bln USD related to the loss of access to land and mine contamination. Due to the contamination of territories, farmers are losing 930 USD per hectare, with costs for full clearance and land release amounting to another 1781 USD per hectare. This constitutes a significant financial burden for a farmer, many of whom — as indicated above — try to clear their land with cheaper means or even themselves. Top Lead projects that the annual loss of potential profits due to ERW-contaminated territory will reach 800 mln USD annually.

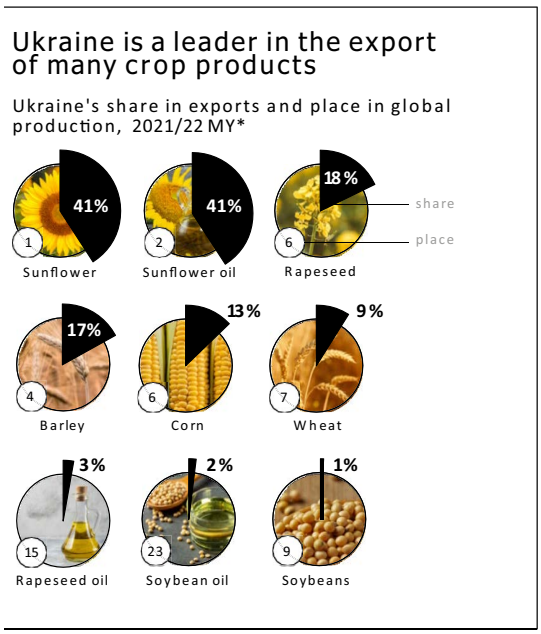
Crops grown on potentially contaminated territories enabled them to feed around 81 million people globally. Given the high importance Ukrainian agriculture plays not only in the national economy (over 10% of GDP) but also for global food security, it is imperative to ensure swift normalization of economic activity in the agricultural sector of Ukraine as soon as possible.

In the understanding of this urgency, the Government of Ukraine considered and in March 2023 approved a 4-year Plan on priority survey and cancellation/clearance of **470,854 ha** of potentially contaminated agricultural land. Priority

[2] Reference from **Mine Action Review 2023: Ukraine** at footnote 6: "'We couldn't wait': Ukrainian farmers improvise to clear their land of mines", The Guardian, 19 June 2023, at: https://bit.ly/44IX13N; Ukraine's Ministry of Agrarian Policy and Food website, 21 March 2023, at: https://bit.ly/3r0lphu; and "Clearing land mines by hand, farmers in Ukraine risk their lives for planting season", CNN, 27 March 2023, at: https://bit.ly/3PURnrf.

Importance of Ukrainian Land

Ukraine is one of the world's leading exporters of agricultural products due to its large arable land area and favorable climatic conditions. The country is an essential player in the world food market and ensures global food security.



Source: Top Lead Survey, November 2023, GLOBSEC calculations from Walking on Fire: Demining in Ukraine report

has been given to minor contaminated lands with perennial plantings or those used for growing vegetables, melons and gourds in Mykolaiv and Cherkasy regions, but also in Dnipropetrovsk, Zaporizhzhia, Kyiv, Sumy, Kharkiv, Kherson, Chernihiv regions. By mid-December 2023 there had been **268,500 ha** surveyed (over 50% of those planned for 4 years) with 205,000 ha released for further exploitation.

IV. ENVIRONMENTAL IMPACT AND QUALITY OF SOIL

However praising efforts of the Government of Ukraine to resume economic and agricultural activity in Ukraine as soon as possible, getting land cleared and released for further use will not be enough. Plenty of good scientific research has been undertaken about the impact of warfare on ecology, biodiversity and the quality of soil, air, water etc. As we wrote in our previous research on demining, harm from mines and other EOs '*are intensely poisonous to the environment: they damage soil as fragmented explosives release heavy metals like chrome, zinc, iron, copper, and mercury; later these enter groundwaters and contaminate the Dniester, Dnipro and Siverskyi Donets rivers, thus seriously affecting water safety'. Some* **estimate** *that the land area of grain crops could be reduced by 45% after two years of war.*

In contemporary warfare, contamination of soils in a war-affected land is mostly caused by explosive compounds. As it was perfectly laid out by Giacomo Certini[3], '*explosives are mainly nitroaromatic: 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), nitroglycerin, 1,3,5-trinitrobenzene (TNB), dinitrobenzene (DNB), N-methyl-N,2,4,6-tetranitroaniline (tetryl), and 2,4,6-trinitrophenol (picric acid) are some of the most frequently used, each of which shows specific environmental risks[4]. These compounds generally have high persistence in soil due to intrinsic recalcitrance to volatilization, hydrolysis, and biodegradation. Here, they can be dangerously taken up by edible plants[5] or eventually end up contaminating groundwater[6].'*

[3] The Impact of Warfare on the Soil Environment by Giacomo Certini, Riccardo Scalenghe, William I. Woods, Earth-Science Reviews, http://dx.doi.org/10.1016/j.earscirev.2013.08.009

[4] Qasim, M.M., Moore, B., Taylor, L., Honea, P., Gorb, L., Leszczynski, J., 2007. Structural characteristics and reactivity relationships of nitroaromatic and nitramine explosives — a review of our computational chemistry and spectroscopic research. Int. J. Mol. Sci. 8, 1234–1264.

[5] Price, R.A., Pennington, J.C., Larson, S.L., Neumann, D., Hayes, C.A., 2002. Uptake of RDX and TNT by agronomic plants. J. Soil Contam. 11, 307–326.

[6] Singh, J., Comfort, S.D., Hundal, L.S., Shea, P.J., 1998. Long-term RDX sorption and fate in soil. J. Environ. Qual. 27, 572–577; Tucker, W.A., Murphy, G.J., Arenberg, E.D., 2002. Adsorption of RDX to soil with low organic carbon: laboratory results, field observations, remedial implications. Soil Sediment Contam. 11, 809–826.

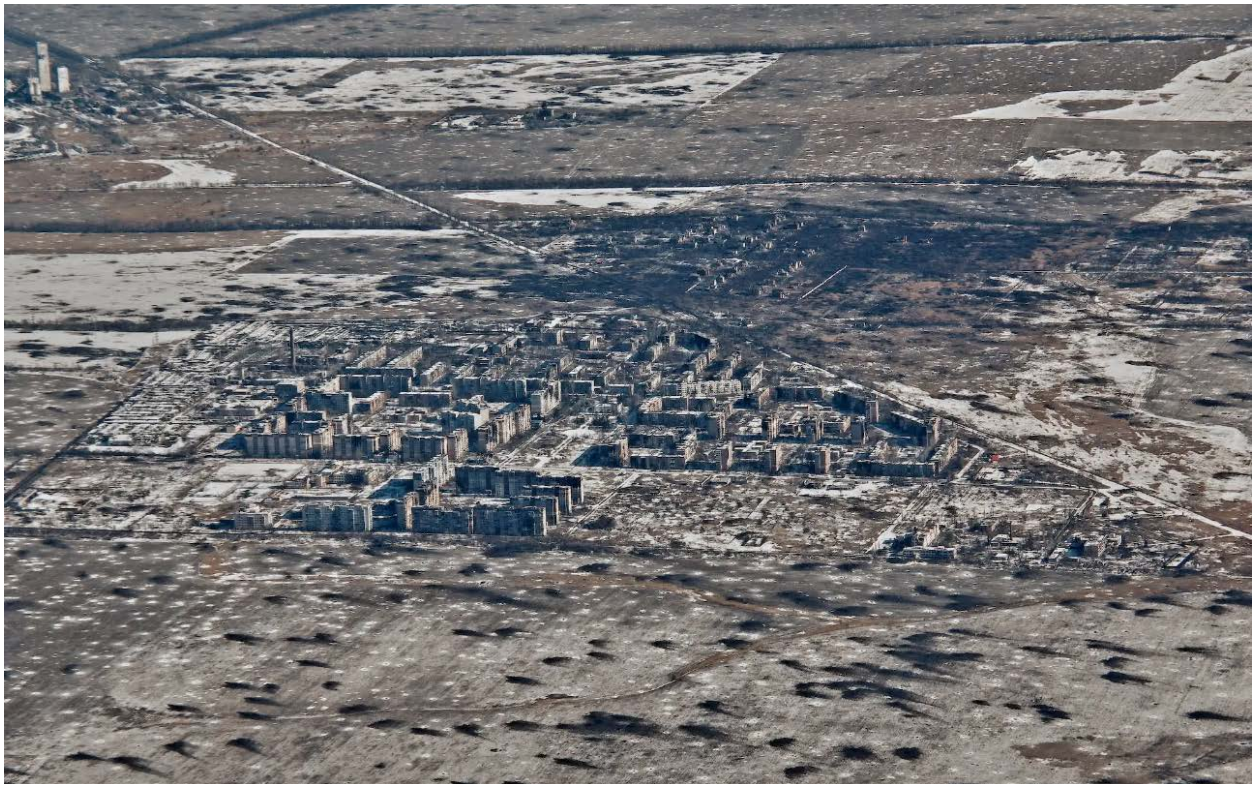
The Ukrainian NGO "Center for Ecological Initiatives "Eco-Action"' further **develops** that: '*during firing, ammunition with different compositions of gunpowder and explosives is used, the combustion of which produces substances such as nitrogen, soot, hydrocarbons, lead, manganese dioxide, and other derivatives, which negatively affect human health and the natural environment. For example, during the explosion of one 115 mm high-explosive munition equipped with hexane, about 4,000 litres of gas is formed, which contains the combustion products of this explosive substance. Up to 30% of gases are dispersed in the air, and most of them (heavy fractions and heavy metals) settle on the soil. Explosives also play a significant role in the release of metals into the soil environment. Particles ejected from artillery strikes have been found to contain high levels of lead (Pb) and copper (Cu). Explosive grenades were also considered a significant source of high concentrations of lead (Pb')*. They suggest that 'the *impact of explosions on the environment does not depend on nature of detonation (be it in combat actions, trainings or utilization). Therefore, harm to the environment caused during the utilization of unexploded ordnance is equal to that of explosions during hostilities. The de-mining of territories has equally negative impacts, as the humus horizon is destroyed, the physicochemical properties of the soil are lost, and the granulometric and aggregate state changes, subsequently affecting the potential fertility and water-holding capacity of the soil. Detonation contaminates the soil with metal fragments and explosive residues.'*

It has been observed that the Russians have also deliberately targeted farming areas and agricultural land for contamination to render it impossible to use for economic activity. There are a few experts in Ukraine who **argue** that an initial special assessment of soil contamination should be made BEFORE any EO clearance is conducted. Resuming agricultural activity without proper assessment of the quality of soil could lead to the production of lower-quality goods. Some extreme assessments of ecologists call for the prohibition of the use of agricultural lands before soil assessment and analysis of their chemical composition have taken place. Otherwise, they warn, Ukraine might be running a risk of losing its place in world markets of agricultural products.

The suggested soil contamination assessment should not be a detailed and specific one. It would be enough to identify major heavy metals and/or oil products and their concentration level with the help of a portable mass spectrometer. This assessment will enable to identification and categorisation of territories subject to conservation, decontamination (from particular pollutants), re-profiling of its usage or immediate release. This will also save time for demining works on territories suitable for conservation only. Unfortunately, Ukraine does not have any specific laboratory where such a soil analysis could be done. Therefore, the assistance of its foreign partners here will be also welcomed.

Picture: Shell craters covered with snow near Bakhmut (land bombturbation), November 2023.
*Credit: Image bank of the war in Ukraine official **website***

Screengrab of Ukrainian drone footage shows the ground covered with craters from artillery shell explosions in the destroyed village of Stepove near Avdiivka, Ukraine.
Photo / AP. Credit: Image bank of the war in Ukraine official ***website***



An aerial view of Vuhledar, the site of heavy battles with the Russian troops in the Donetsk region, Ukraine, on February 10, 2023, AP Photo/Libkos.
Credit: Image bank of the war in Ukraine official ***website***

▶ Land Restoration: Conservation or Re-cultivation?

The emerging challenge of land restoration is another elephant in the room alongside demining itself for the same reasons: scale, size and intensity of contamination.

Naturally, the most affected will be territories along the frontline (the way it moved in 2022-2023) and those under temporary occupation when the front-line will be moving in 2024. The imaginative level of contamination could be assessed by a simple calculation of the daily rate of consumption of artillery shells in 2022-2023, which an average amounted

to **20,000-45,000** shells per day from the Russian side (reaching its peak of 80,000 shells per day in certain periods), and about 6,000-10,000 shells per day from the Ukrainian side. These figures do not include missile and drone strikes, scaled distant dispersion of mines and chaotic minefields set by Russians, usage of small arms etc.

Intense shelling or bombs can cause an effect known in science as ***bombturbation*** where the soil *"is removed to some extent by the explosion, leaving a pit. The soil collaring the pit, although remaining in place, is turbated, compacted, and contaminated by metallic fragments and ash. Bombturbation dismantles the status-quo sequence of horizons and, more importantly, makes the ground irregular, with obvious consequences on the hydrology and the workability of soil. Physical disturbance is often accompanied by chemical contamination, which makes soils unsuitable for production purposes and for supporting human welfare in general"*[7].

▶ Impact from Unexploded Ordnance

A huge amount of work for deminers will be related to the disposal of unexploded ordnance, which apart from risks to human safety also poses a serious detrimental impact to the environment and quality of soil. According to the Ukrainian military, in the war, Russia uses old ammunition produced over 30 years ago, **40%** of which either does not explode or its explosive substances do not burn out completely and pollute the air. In some cases, in liberated areas, even unexploded 500-kg bombs were found. International demining experts estimate a dud rate of Russian munitions between **10 and 30 percent**, with cluster munitions reaching **40%**. In times of ongoing war, it is difficult to make more precise assessments and calculations, but even approximate figures are quite staggering. In 2022 Russia alone fired around **11 million** artillery rounds, which might amount to over 2 million UXO on the territory of Ukraine left from artillery shells in 2022 only. With the running out of industrial capacity to produce enough shells themselves[8] Russia has already resorted to importing a lot of ammunition from friendly countries like Iran and North Korea, which allegedly have almost the same dud rate at around **20-25%**.

▶ Conservated Territories and Abandoned Zones

Whereas the government of Ukraine is determined to bring back to exploitation as much land as possible, there will be certain objective limitations to that, given the extent of contamination of the soil. Ukraine will be forced to consider options for land restoration, which could be roughly grouped into re-cultivation[9] and conservation[10].

We have to be prepared that Ukraine will be facing the task of declaring some of the war zones as conservated territories or reserved zones, which cannot be used for any type of human activity, like the Zones Rouge in France from WW1 (see Case Box 1). Already some experts in EO and military engineers warn that areas like Bakhmut, Avdiivka, Marinka etc will be impossible to clear and decontaminate from mines and other EO. The pictures above illustrate significant detrimental effects to the soil caused by bombturbation in areas adjacent to these Ukrainian cities and towns.

---

7 The impact of warfare on the soil environment Giacomo Certini, Riccardo Scalenghe, William I. Woods, Earth-Science Reviews, http://dx.doi.org/10.1016/j.earscirev.2013.08.009

8 To some expert estimates Russia has a capacity to produce only **2 mln shells** per year.

9 Centre for Ecological Activities "Eco-Action" **recommends** following land-restoration practices:
- Phytoremediation: Treatment of a polluted area with concentrator plants to eliminate pollutants by splitting the pollutant with plant roots into a less toxic element or absorbing the pollutant, accumulating it in the stems and leaves of the plant.
- Phytoextraction: Planting of high-biomass plants that absorb and accumulate heavy metals (for example, As, Cd, Zn), excess cations (for example, Na), or nutrients (for example, PO4, NO3, NH4) in the shoots. They are then harvested and disposed of safely.
- Cleaning the territory: Mechanical cleaning of the surface, maintenance of sanitary conditions.
- Agrotechnical melioration: Weakening of surface runoff and transferring it to internal soil one.
- Land re-cultivation is the process of transforming contaminated land into usable land by normalising soil conditions and reducing chemical exposure to plants. This approach largely depends on the nature and degree of contamination, the intended purpose or use of the site to be restored, as well as the availability of effective and cost-effective technologies. Physico-chemical soil characteristics and climatic conditions are also important issues when choosing re-cultivation methods.

10 Land conservation is the practice of partially or fully restricting the use of a land site for economic purposes for a specified period of time. Conservation is resorted to in the case when the use of land is neither ecologically nor economically expedient, as well as when land sites contain man-made pollution, making it impossible to obtain ecologically clean products and dangerous to the health of people present. Conservation of such land involves grass restoration, afforestation, or renaturalisation to restore the fertile properties of the soil. In land management science, a distinction is made between conservation-rehabilitation — after a certain period pause, the land is returned to cultivation — and conservation-transformation, which means that degraded land is irreversibly removed from arable land (from the **The impact of Russia's war against Ukraine on the state of the country's soil**)

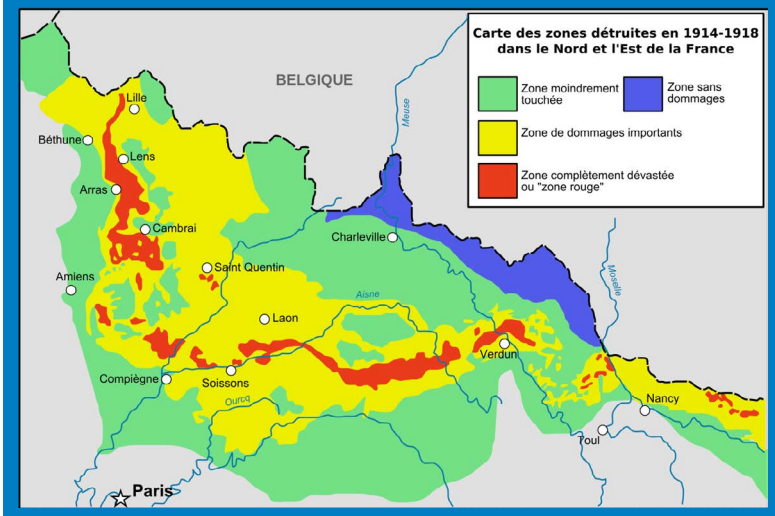
CASE BOX: ZONES ROUGES OF FRANCE[11]

The Zones Rouges — an archipelago of former battlegrounds [of the WWI] so pockmarked and polluted... that, more than a century after the end of hostilities remain unfit to live or even farm on.

Four years of war [of 1914-1918] stripped a zone on either side of the largely immobile frontline of any sign of life. Roads and bridges, canals and railways were destroyed. Cities were pummeled into dust. Entire villages 'died for France' and were wiped off the map for good... Bombardments were so thorough that even grass and trees disappeared. When the war ended in November 1918, a large swathe of northern to eastern France was so cratered up and chewed out that it looked like a moonscape. In all, about 7 percent of French territory was destroyed...

By 1919, the French Ministry for the Liberated Territories had divided the afflicted areas into three zones, depending on the degree of destruction:

- Zones vertes ('Green Zones'), with minimal damage;
- Zones jaunes ('Yellow Zones'), with heavy but limited damage; and
- Zones rouges ('Red Zones'), usually closest to the former front lines, which were completely destroyed.



Credit: Guicherd, J. & Matriot, C.: La terre des régions dévastées – Journal d'Agriculture Pratique 34 (1921). CC BY-SA 2.5

Green, yellow and red zones of northern France, were affected by WWI. The blue zones were spared destruction.

The green and yellow zones were returned to civilian use relatively early. The red zones were different. They were, in the words of one official post-war report, "completely devastated. Damage to properties: 100%. Damage to agriculture: 100%. Impossible to clean. Human life impossible." Red zones were cleared only superficially, and mostly just closed off.

Today, the red zone archipelago has shrunk [from the original 1,800 km^2] to about... 100 km^2, about the size of Paris. Yet it's unlikely that these islands will disappear soon. They are the most tenacious residue of a long-lasting environmental problem...

France's Sécurité Civile, which is charged with removing them, estimates that at current rates, it could take up to 700 years to completely clear all remaining WWI shells and grenades from France's soil. And then there are the gases, acids, and other chemicals polluting the soil — in some parts, the ground still contains so much arsenic that nothing will grow. In less affected areas, biologists still note the lack of floral and faunal diversity related to the pollution, which some estimate may take about 10,000 years to clear.

The French government declared the area uninhabitable due to chemical contamination and the presence of unexploded ordnance.

Restoration of the land will be no less (end in some cases even more) costly than a demining itself. Ukraine and its international partners should already plan ahead for this important work if we want to restore the fertility and quality of 19% of agricultural land in Europe that is located in Ukraine. The next two tables below provide rough assessments of potential costs for land restoration.

[11] Extracts from the **article** of Frank Jacobs for the Big Think

Table A: Estimated cost of using soil restoration technologies

N°	Technology	Estimated cost
1	Agriculture	Laboratory studies from USD 20,000 (1 m^3), pilot studies from USD 100,000; Treatment of 1 m^3 of soil up to USD 100
2	Stabilization	The cost of technology with reagents (per 1 m^3) is from USD 50 to USD 120 for surface pollution, from USD 200 for deep pollution. The cost of the equipment is set separately. It is from USD 200,000, depending on the characteristics of the territory, the cost of electricity
3	Phytoremediation	The cost of 1 hectare with a capacity of 0.5 m of soil ranges from USD 150 to USD 250,000.
4	Composting	The cost of the technology depends on the amount of treated soil, the availability of additives, the type of pollutants and is USD 200 per 1 m^3 when processing 20,000 m^3 of soil
5	Chemical leaching (washing)	The cost of the technology ranges from USD 30 to USD 300 per 1 m^3 of soil, taking into account the type and concentration of substances included in the solution
6	Thermal desorption	The cost of treatment ranges from USD 10 to USD 70 per 1 m^3 of soil. Pilot studies cost from USD 10,000. The concentration of pollutants, landscape and geochemical conditions determine the upper limit of the cost
7	Chemical extraction	The cost of technology is estimated from USD 150 to USD 500 per 1 m^3 of soil
8	Chemical oxidation/redox	The cost of the entire process is estimated to be between USD 200 and USD 500 per ton of treated soil, excluding the cost of analytical studies
9	Burial	The cost of 1 ton is from USD 1,000,000

Source: UA NGO Center for Ecological Initiatives 'Eco-Action' report **The impact of Russia's war against Ukraine on the state of the country's soil** *(November 2023)*

Table B: Correlation between the level of damage and recommended restoration methods

Damage level (% of the site area)	Land suitability categories	Characteristics of contaminated soil	Usage	Necessary measures
Very low damage (Up to 10% of the site area)	Definitely suitable	The content of chemical substances in the soil is within the background values.	Conducting agricultural activities. Cultivation of any crops.	Not required.
Low damage (10–25% of the site area)	Suitable	The content of chemical substances in the soil exceeds the background level value, but not higher than the MPC.	Use for any crops subject to quality control of agricultural products.	Implementation of agrotechnical measures to reduce the entry of metals into products (liming, application of organic and mineral fertilizers).
Moderate damage (25–50% of the site area)	Not very suitable	The content of chemicals in the soil exceeds the MPC at the limiting translocation rate.	Use for industrial crops without receiving food and feed from them. Use for hayfields and pastures with standardized grazing.	Phytoremediation, selection of agricultural crops that do not accumulate pollutants. Carrying out agrotechnical measures.
High damage (50–75% of the site area)	Conditionally suitable	The content of chemicals in the soil exceeds the MPC for most of the studied pollutants.	Use for cultural pastures. Cultivation of essential oil crops.	Anti-erosion, hydrotechnical, physical and chemical recultivation. Exclude cultivation of crops for food purposes.
Catastrophic damage (75-100% of the site area)	Not suitable	The content of chemical substances in the soil exceeds the MPC for all indicators.	Exclusion from agricultural use. Conservation.	Natural recovery

Source: UA NGO Center for Ecological Initiatives 'Eco-Action' report **The impact of Russia's war against Ukraine on the state of the country's soil** *(November 2023)*

V. DIFFICULT TERRAIN: FORESTS AND AQUATORY

Different types of terrain might require different mine detection tools and, therefore, add to the complexity of demining. Whereas it is relatively simpler to survey a flat territory of fields with the help of mechanized demining (machines and robotic systems), areas like forests and aquatic territories would require specific tools and knowledge to clean the territory from EO. The precise size of contaminated nature conservation areas could be determined only after full de-occupation and survey of the territories. The indicative size of EO contaminated area with aqua resources included constitutes 250,163.84 ha or 2,501,638 sq km.

▶ Forests[12]

Since the full-scale invasion in February 2022 around 2,9 mln ha of forests have been affected; 824 forest fires happened on 22,134 ha of the land. Occupied forestry territories and those along the frontline constitute over 800,000 ha. The movement of heavy military equipment alongside combat actions in forests is leading not only to heavy contamination but also to the destruction of the ecosystem of terrain, soil, and aquatic objects. In the long run, an accumulation of solid wastes, destroyed military equipment and EO will severely affect the environment.

From 500 000 ha available for inspection around 73,000 ha have been surveyed and cleaned by January 2024. Out of the remaining 427,000 ha 185,000 ha were defined as priority areas for survey and clearance and submitted for the Government's approval.

The Government of Ukraine is already considering a long-term plan for the restoration of nature conservation areas affected by the war, where the first step will be in the demining of these territories. The strategy will include actions to rehabilitate ruined ecosystems and to create, at least, new 10 contemporary natural parks, 10 rehabilitation centres for wildlife species and to monitor the restoration of biodiversity. All these efforts will definitely require international assistance and support in the mid-term perspective.

▶ Aquatory

One of the obvious forthcoming challenges in HD is the contaminated aquatic resources of Ukraine. Assessments come up with a figure of around **13,500 sq km** altogether and around 7300 sq km in de-occupied territories. These are water areas of reservoirs, rivers, lakes, ponds, Black and Azov Seas. Priority in underwater demining is given to bridges and hydraulic constructions, rivers, lakes, water reservoirs, sea and river ports, and aquatories of the Black and Azov Seas. Actual underwater HD works are being conducted in Kyiv, Chernihiv, Sumy, Kharkiv, Kherson and Zaporizhzhia regions mostly by pyrotechnic units of the State Emergency Service of Ukraine (SESU) and military engineer units of the Special Transport Service of Ukraine.

With the destruction of the Kakhovska Hydro Electro Power dam in June 2023, a mine and other EOs contamination map has changed shape completely: many shells and mines have surfaced and floated to different places along the flood routes; some of them went onto the Black Sea, some laid at the bottom of the Dnipro River. **Mine Action Review 2023** on Ukraine writes: *'The HALO Trust (HALO), which has been surveying and clearing mines along the Inhulets river, a tributary of the Dnipro, since the beginning of 2023, has been forced to suspend clearance work on seven flooded minefields. ...the torrent of water that swept through the lower Dnipro was powerful enough to dislodge landmines and, in some cases, caused 10 kg anti-vehicle mines to detonate. The mines were laid at the lowest points of the river to prevent troops from crossing in vehicles while the area was under Russian occupation'*. No exact number of displaced landmines could be determined even after the waters have subsided due to silt and clay. According to the **State Ecological Inspection of Ukraine**, demining works on these territories could take around 15 years as EO is difficult to detect and identify in this mud and extract from dried-out soil. These territories are likely to become new national conservated areas as well.

As to the scope of the work of HD in the Black and Azov Seas, a special monitoring operation needs to be undertaken[13]. Yet, it is not safe to conduct it for the time being due to the active presence of Russian aviation in the area. Against the background of decreased activity of Russia in the mining of the Black and Azov Seas owing to the successful countermeasures of the Security and Defence Forces of Ukraine, the Naval Forces of Ukraine are confident that the complex operation to demine the Black and Azov Seas will take around 3-5 years and in 3-5 months it will be possible to demine the main naval routes. However, they admit that the aftereffects of this mine contamination will be felt far longer.

---

12 All the data in this section is based on an official reply of the Ministry of Ecology of Ukraine from 11 November 2023 to GLOBSEC inquiry.

13 However, these demining works attribute to humanitarian demining, they are conducted in Ukraine by Security and Defence Forces.

Actual demining works could begin when a certain level of security is achieved as existing minesweepers that Ukraine possesses are not equipped with the necessary weapons capable of protecting them from Russian aviation. Respective plans for prospective work on HD in the area are being set now by a special authority of the Naval Forces of Ukraine. A new mine action division has been recently set up within it, with its specialists undergoing intense training in underwater demining. With the help of international partners Ukraine has become equipped now with modern minesweepers, specialised surface and underwater drones like Sonobot and Chaisin, and other searching[14] and remote mine-activation equipment. New unmanned boats to destroy influence mines are also being tested now. Yet, the scope of work in the area of underwater demining is immense, and — as in other segments of HD — it is largely dependent on the resources available.

VI. MEASURING PROGRESS: DELTA SINCE APRIL 2023

In the previous report, we highlighted the scarce resources Ukraine had for HD activities, both in terms of personnel, personal protection equipment, individual tool kits, as well as machinery for mechanised demining. We did not touch the issue of mine detection dogs, as at the time of writing, there were not so many of them at service. Since that time the Government of Ukraine together with its international partners have vigorously addressed all these issues and progress is striking. It was assessed by our expert team that the current human resources available as of June 2023 had been very scarce: slightly over 2000 deminers from state operators and about 1500 non-state operators. By our estimation, to be adequately equipped for the challenges of vast territories, which require demining, Ukraine had to reach a figure of around 10,000 deminers.

Developments since April 2023 have demonstrated a vigorous rise in staff and trained personnel. Most of the progress had been observed in certified state operators, some of it in international NGOs operating in Ukraine and less with Ukrainian non-state actors. By the end of 2023, the Ministry of Interior (MOI) doubled its staff on HD up to 3000 people since the beginning of the year. The Ministry of Defence of Ukraine reported about expected increase of up to 6500 deminers in the Security and Defence Forces in the coming months. Extra units have been formed for underwater demining. Overall plans for 2024 (those known certified operators only) anticipate almost doubling the human resources available, thus, capable of reaching or even exceeding the targeted amount of 10,000 staff by the end of the year. These figures do not include for the time being a potential number of demining groups, which will be formed by newly certified operators (an extra 16 have been added since April 2023) and another 44 waiting for certification.

The same advancement had been observed in equipment for mechanized demining and mine detection dogs. The chart below provides data on the available and expected increase in resources over the next year.

Resource availability by different operators*

Institution	Sappers/Deminers 2023/2024 (est)		Machines/ robotic 2023/2024 (est)	MDDs 2023/2024 (est)		Underwater demining
Support Forces to UAF[15]	1300	2296 (9800) All Defence and Security Forces (est 4800 of SF UAF and SSTSU only)	7 (+4)	18 (+26: +13)	(50) All Defence and Security Forces	Special command unit on underwater HD at Naval Forces
State Special Transport Service of Ukraine (SSTSU)	230 people (Apr'23) About 1000-Oct'23 About 3000-May'24		1(DOK-ING in Dec 23)			3 special units
SESU	1500 (5000)		15 (+20 expected) 9 robotic systems 5 catamarans for underwater demining 22 drones	6 (donated by NPA in April 2023)		22 special units

[14] Like, for instance, mine detector designed to identify mines, improvised explosive devices and other UXO at up to 30m bottom depth.

[15] Figures given for SF to UAF are about resources available for humanitarian demining only

Institution	Sappers/Deminers 2023/2024 (est)	Machines/ robotic 2023/2024 (est)	MDDs 2023/2024 (est)	Underwater demining
		430 units of demining vehicles		
MI/Police		1	n/a	n/a
National Guard		no	n/a	n/a
National Border Guard	n/a	no	n/a	n/a
GK Group	36 employees (31 sappers) (+4 employees)	no	no	none
Demining Solutions	50	no	no	none
UkrOboronService	100	n/a	no	none
Ukrainian Deminers Association	n/a	no	no	none
HALO Trust	1,072 (incl 923 operations staff) (1,600)	14 remote vegetation cutting machines (Robotcut) 2 front-loaders and 1 Armtac (11)	no	none
FSD	23 (intl) & 307 (ntl) staff. (+10 (intl) and 150 (ntl) staff.	2 mechanical ground preparation machines (MV 10 and MV 4) 2 Front End Loaders 2 Excavators for rubble removal	(exp 4 MDD teams)	none
DRC (Denmark)	45 people in multi-task teams 48 people in NTS teams 44 people in risk education teams 7 people in victim assistance (VA) activities	(2-4 machines by end 2024)	no	none
NORWEGIAN PEOPLE'S AID	20 (intl) and 177 (ntl) staff (of which 12 NTS/EORE teams and 16 multi-task teams (MTTs)	(3 remote-controlled demining machines 2 remote-controlled vegetation-cutting machines)	8 (the first to obtain accreditation for using MDDs for demining operations)	none
Danish Church Aid	80 employees	n/a	n/a	none
Mine Advisory Group (MAG) (UK)	n/a (potential start of survey and clearance works in 2024)	n/a (plans to have mechanical demining teams and equipment)	n/a	none
"UKRAINIAN DEMINING SERVICES" ("UDS" LLC)	102 employees (88 sappers), 9 teams. (Est 250 employees, 188 sappers).	9 machines Bozena 4+ and Bozena 5+ (+6 remote control machines)	none	(1 unit)
SAFELANE GLOBAL UKRAINE, LLC	no data for the time being, but, probably, will probably use resources of the mother company in the UK[16]			
FREE WAY LLC	15 sappers (15 more are currently training) (100 sappers; NTS and EORE)	In perspective	no	no

[16] SAFELANE GLOBAL Ukraine LLC is an official representative of SAFELANE GLOBAL (UK)

Institution	Sappers/Deminers 2023/2024 (est)	Machines/ robotic 2023/2024 (est)	MDDs 2023/2024 (est)	Underwater demining
Charity Fund Modern Village and Town Charity	**5 people** (EORE)	no	no	no
Charitable Organization International Charitable Fund **BIG UA**	**4 sappers**	no	no	no
Department of Shipping Safety, Security and Mine Action, **LLC AGRICULTURAL ENTERPRISE NIBULON**	**One team**	1 (+3) **GCS-200** mechanical demining platforms	n/a	n/a
Public Association **SAFE PATH GROUP**	1 **clearance team** (NTS and BAC)	n/a	n/a	n/a
Limited Liability Company «Research And Production Company Patron Demining» (LLC «**RPC PATRON DEMINING**»)	**Training of 1000 sappers a year**	n/a	n/a	n/a
Total for all Defence and Security Forces	2296 (9800)	min 39 (+50)	min 24 (+50)	25 units (+1)
Total for other operators	Approx. 2200 (3100), incl. auxiliary staff		8 (8+4 MDD teams)	

* *figures are given as of the end of 2023; in brackets are those estimated by end 2024*

** *those certified operators not reflected in the table either do not have any information in public access or have not provided GLOBSEC with respective info upon requests*

Source: GLOBSEC proceeded data, obtained upon official requests to operators and/or open sources

VII. INCREASING NUMBER OF CERTIFIED OPERATORS

The Government of Ukraine is determined to have as many operators in HD as possible to cope with the size of the challenge. With this aim, it undertakes efforts to speed up the process of certification of the companies/NGOs with the required qualifications, who are willing to work on the market. It has streamlined the procedures and made them simpler. To date, 29 operators have been certified by two accredited agencies — the Center for Mine Action (adjacent to MOD, Chernihiv) and the Inter-Regional Center for Humanitarian Demining (adjacent to SESU, Merefa). Forty-four more organizations (both, international and national) have applied for certification and are expected to receive it in 2024. There are reasonable concerns, however, that the respective small units in the mentioned two Centers will be capable of processing all the applications in a smooth and timely manner, without losing the quality of thorough inspection and verification of the necessary qualifications of the applicants. Another concern still remains about certain corrupt practices that could be in place when the human factor is concerned. Some of the international applicants with recognized credentials in demining practices and life experience as explosive ordnance instructors and military engineers complain that instead of the declared three months for certification, they were told to wait for eight more due to the long queues in applications and excessive workload of the centres. The Government of Ukraine is resolved to continue the improvement of the certification with more digitalisation of procedures to make all those processes transparent and to reduce the impact of the human factor.. These efforts should be welcomed and the Government should be encouraged to continue.

Certified operators on demining in Ukraine

N°	Operator	Certified for	Certificate validity period
1	Demining Solutions (Ukraine)	NTS, TS, Manual demining, Mine Clearance	27.06.2023-26.06.2028
		Risk education	27.06.2023-26.06.2024
2	GK Group (Ukraine)	NTS, TS, Manual demining, Mine Clearance	13.03.2023-12.03.2028
3	The Ukrainian Deminers Association/UDA (Ukraine)	Risk education	11.10.2022-10.10.2025
		NTS	16.06.2023-10.10.2025
4	Center for Humanitarian Demining SC UkrOboronService (Ukraine)	NTS, TS, Manual demining, Mine Clearance, Liquidation of ERW	06.09.2022-05.09.2023
		Risk education	17.10.2023-30.04.2024
5	The Mines Advisory Group, Filial in Ukraine	NTS	29.08.2023-23.03.2026
		TS, Manual demining, Mine Clearance	10.11.2023-23.03.2026
		Risk Education	24.03.2023-23.03.2026
6	Charity Organization Charity Fund Modern Village And Town	Risk education	14.04.2023-13.04.2026
7	Department of Shipping Safety, Security and Mine Action, LLC AGRICULTURAL ENTERPRISE NIBULON	NTS	28.04.2023-27.04.2026
8	International Demining Group Limited Liability Company (IDG LLC)	NTS, TS, Manual demining, Mine Clearance	15.12.2022-14.12.2023
9	Charity Organization Charity Fund «Fondation suisse de déminage» FSD in Ukraine	NTS, TS, Manual Demining, Mine clearance	22.02.2023-21.02.2028
		Risk education	22.02.2023-21.02.2024
		Mine clearance using machinery and equipment	26.06.2023-27.04.2027
10	Representative office of The HALO Trust in Ukraine	NTS, TS, Manual demining, Mine Clearance,	13.04.2023-12.04.2028
		Risk Education	18.10.2023-17.09.2024
		Liquidation of EWR	20.12.2023-19.12.2024*
11	Representative office of the Danish Refugee Council in Ukraine	NTS, TS, Manual demining, Mine Clearance, Risk Education	08.12.2022-07.12.2027
12	Filial of Norwegian People's Aid in Ukraine	NTS, Risk education,	15.02.2023-14.02.2026
		TS, Mine clearance, Manual demining	07.06.2023-14.02.2026
13	Limited Liability Company «Research And Production Company Patron Demining» (LLC «RPC PATRON DEMINING»)	NTS, TS, Manual demining, Mine clearance	20.10.2023-16.05.2024
14	Separate Subdivision Of The International Handicap Federation In Ukraine	Risk Education	21.07.2023-20.07.2024
15	DanChurchAid Ukraine	NTS, Risk Education	15.07.2023-14.07.2024
16	Charitable Organization International Charitable Fund BIG UA	NTS, Risk Education	15.09.2023-14.09.2024
17	Public Association SAFE PATH GROUP	NTS, TS	20.10.2023-22.09.2024
18	Demining Center	NTS, TS, Manual Demining, Mine clearance	14.10.2023-13.10.2024

19	Limited Liability Company SAFE GROUND SOLUTION	NTS, TS, Mine Clearance, Risk Education, Manual Demining	13.10.2023-12.10.2026
20	Humanitarian Demining Detachment Interregional Center for Humanitarian Demining and Rapid Response of the State Emergency Service of Ukraine (ICHDRR OF SESU)	NTS, TS, Mince clearance, Risk Education, Manual demining	16.10.2023-15.10.2026
21	Limited Liability Company ARKHIPE-LAH (LLC ARKHIPE-LAH)	NTS, TS, Manual Demining, Mine clearance	13.10.2023-12.10.2024
22	Military unit A3160	NTS	09.11.2023-08.11.2026
23	Private Joint-Stock Company TRANSIMPEX	NTS, TS, Manual Demining, Mine Clearance, Liquidation of ERW	13.11.2023-12.11.2024
24	EMERGENCY AND RESCUE DETACHMENT OF THE SPECIAL PURPOSE OF THE MAIN DEPARTMENT OF THE STATE EMERGENCY SERVICE OF UKRAINE IN MYKOLAIV REGION*	NTS, TS, Manual demining, Mine clearance, Liquidation of ERW	21.11.2023-20.11.2024
25	Subsidiary of the State Company Ukrspecexport — State Enterprise Ukroboronservice*	NTS, TS, Manual demining, Mine clearance, Liquidation of ERW	18.12.2023 — 17.12.2028
26	Limited Liability Company MELLOM PRO (LLC MELLOM PRO)*	NTS, TS, Manual demining, Mine clearance,	26.12.2023-25.12.2024
27	Limited Liability Company “UKRAINIAN DEMINING SERVICES” (“UDS” LLC)*	NTS, TS, Manual demining, Mine clearance, Risk Education	01.01.2024-31.12.2024
28	Limited Liability Company SAFELANE GLOBAL UKRAINE (SAFELANE GLOBAL UKRAINE, LLC)	NTS	06.12.2023-05.12.2024
29	FREE WAY Limited Liability Company (FREE WAY LLC)	NTS, TS, Manual demining, Mine clearance, Risk Education	08.12.2023-07.12.2024

Source: National Mine Action Authority of Ukraine, December 2023

**data from the website of the Interregional Center for Humanitarian Demining and Rapid Response of the State Emergency Service of Ukraine* https://mcgr.dsns.gov.ua/protiminna-diialnist-1/rejestr-vidanix-sertifikativ

VIII. GENDER BALANCE

While the Government of Ukraine is still working on formal provisions to improve the gender factor in humanitarian demining, which will be reflected in the respective Strategy on Mine Action in Ukraine (see respective chapter below), there are natural processes in war-torn Ukraine that bring more and more women to the profession. These are mostly linked to the mobilization and conscription of the male population to the Armed Forces of Ukraine, high demand for deminers and rather attractive salaries, which range from 17,000 to 50,000 UAH in different regions of Ukraine. Naturally, a greater percentage of women are engaged in non-technical surveys, victim assistance and EORE, but there are also rising numbers of female deminers, sappers, military engineers and sapper-divers. In some of the international NGOs working in Ukraine, who are trend-setting examples, the proportion of females in their staff reaches as high as 52%[17], with an average across all the state and non-state operators being around 30%.

IX. TRAINING OF DEMINERS AND RETRAINING

With the ambitious plans of the Government of Ukraine to increase its human resources in demining there is more imperative need to ensure enough training capacities both in Ukraine and the partner countries. At the International Donor Conference in Zagreb (11-12 October 2023) the National Mine Action Authority of Ukraine announced that 5000 personnel of the Security and Defence Forces of Ukraine should be trained in EOD and demining

[17] For instance, MAG (UK).

activities. Existing training centres in Ukraine in Merefa, Chernihiv and Kamyanets-Podilskyi, as well as the Military Divers' School[18] obviously find it hard to satisfy all the needs in training. Ukraine has been grateful to those international partners that have already offered their facilities in 2023 and will continue to do so in 2024. Among the leaders of them are EUMAM, MAT Kosovo, Japan-Cambodia, Canada, Poland, USA (Tetra-Tech) and many more. With a view to the growing needs in aquatic demining, there is a potential for littoral partner countries that have a developed school of underwater demining to consider options of offering training services for Ukraine. More emphasis should be also placed upon the training of operators of mechanized demining and MDDs' (mine detection dogs) handlers as these segments of HD in Ukraine also show an exponential rise and demand.

Separate acknowledgements should be made to public initiatives in Ukraine aimed at supporting the training capacities of the existing schools. One of the examples is The People's Project School of Military Divers, which is supported by the People's Project[19] association of volunteers and veterans with knowledge, equipment and training facilities. Also, in November 2023 a new Mine Action Training Center was opened in Chernihiv region with the support of Metinvest Group and fundraising platform United24. It is planned to train around 3000 specialists in HD there.

In November 2023, the Government of Ukraine introduced another important initiative in training, which could help expand the supply of trained specialists on the market. State Employment Service has started to provide special vouchers for training in 'sapper' qualification for those categories of people: IDPs; participants of combat actions; people aged 45years+; those injured as a result of war; disabled persons; people with established facts of personal freedom deprivation as a result of the military aggression against Ukraine. The number of institutions where this qualification could be obtained also expanded to nine:

- National University of Civil Protection
- Zhytomyr Police Academy
- Lviv State University of Life Safety
- National Academy of Land Forces of Ukraine n.a. Hetman Petro Sahaidachnyi
- Special Center of Rapid Response of the State Emergency Service of Ukraine
- Training Center n.a. Vasylia Vyshyvanoho of the National Guard of Ukraine
- Inter-Regional Center of Humanitarian Demining and Rapid Response of the State Emergency Service of Ukraine
- Joint Training Center of the Support Forces of Ukraine "Podillya"
- 'Center for Training in Humanitarian Demining' LLC

This is a good incentive, as it also concerns veterans and mine victims to be trained in mine action, as GLOBSEC recommended in its first report.

X. ACCOMPANYING CHALLENGES

There are obviously some accompanying challenges that might affect ambitious plans to bring the number of deminers even to the minimum desirable level. Most importantly, it is about enough equipment for personal protection and deminer kits. Even with existing numbers of staff, all of the Ukrainian operators are talking about the significant shortage of personal equipment and asking international partners/ Ukrainian volunteer groups for support. PPE (personal protection equipment), metal detectors and bomb locators/ magnetometers, mechanical demining equipment, cars to transport personnel, armoured (capsules) vehicles to transport explosives, diving equipment, special boats with deep detection equipment, underwater detectors, personal and group trauma kits, EOD kits, GPSs, compasses, etc. — everything will be of higher demand in the coming months. To equip one group of sappers consisting of 10 people would require **100,000–150,000 USD**.

Thorough calculations should be made to match the number of existing (and future) staff with the equipment available (and potentially received) to use resources most optimally. Perhaps, it would make sense to create fewer demining and EOD teams and train them based on expected assistance to receive donated equipment.

[18] Diving School has been established in Odesa in October 2019 on the basis of the Navy of Ukraine. Among other professions, it trains underwater sappers.

[19] People's Project is a non-commercial and non-profit organization. It is an association made up of volunteers and caring people who coordinate their efforts for social initiatives aimed to support the People of Ukraine.

XI. AVAILABILITY AND NEEDS FOR MACHINES IN MECHANICAL DEMINING

The most commonly used types of machinery for mechanical demining are well explained in IMAS[20]. Basically, they are:

- machines to detonate hazards,
- machines to conduct ground preparation, and
- machines to detect hazards.

Most serial producers in the world would meet the first 2 criteria using **flail or tiller working tools.** All of them are either already present or actively working to operate in Ukraine. Both, the MOD and MOI of Ukraine, as well as international NGOs and major donors, are aware of all these producers. In addition to flail and tiller, rollers also be used, but rather for verification purposes than for actual mechanical mine clearance.

The third option (to detect hazards) can be effectively used on roads and paths to prove they are not mined or otherwise. The only system that is globally combat-proven in this is the Husky blast-survivable vehicle with integrated Ground Penetrating Radar (GPR).

The progress in obtaining different machines and equipment for mechanized demining in Ukraine in 2023 is impressive. When in March 2023 the Ministry of Economy started to work on this issue there were only 12 machines in use of different operators. The First Vice Prime Minister of Ukraine Ms Yuliia Svyrydenko **reported** the expected number of 60 machines of different types in possession of different operators had risen by December 2023 (an extra 10 machines from DOK-ING (Croatia), 10 from Global Clearance Solutions, around 200 pyrotechnic machines, over 600 metal detectors, 50 blasting machines etc). The major donors of equipment were Japan, Canada, South Korea, Switzerland, Lithuania, the Howard G. Buffett Foundation, the Estonian Rescue Association, UNDP and others. The State Emergency Service of Ukraine increased the number of mechanized demining machines from none in January to thirty-one by mid-December 2023, highlighting the optimal need for 45 machines.

The need for this type of HD tool is obvious, as it helps to improve the safety (especially with remote control and teleoperated) and speed of demining. On average, an area that a standard demining machine can do in one day equals 100 days of work of a manual deminer on the same territory. According to international practice, machines are the most important and essential part of technical surveys to quickly reduce SHA down to CHA with mine clearance of the SHA to follow, where the mechanical method is predominantly a major one. Also, mechanical vegetation cutters deployed ahead of manual deminers can replace manual tripwire drills and increase the productivity in clearance rates per deminer per day four-fold[21]. In Croatia, the government gives priority to deploying mechanical assets, as this increases productivity. Ground prepared by mechanical assets allows increasing workable area per one deminer per day from 400 to 800 sq metres[22].

In Ukraine, a lot of machines are currently engaged in emergency demining of unimproved roads and paths, critical infrastructure (electric power lines), in support of future reconstruction as well as demining of open areas next to numerous villages and towns in de-occupied territories. Unprecedented use by the enemy of air bombs, rockets, munition of larger calibres, and vastly scattered sub-munition mixed with different types of mines and IEDs cause a lot of problems for mechanical demining teams reducing the clearance pace if compared to the one demonstrated during official equipment tests or demining of standard minefields.

Nevertheless, according to SESU, by 30 November 2023, all their 19 mechanical teams cleared over 4,8 sq km (480 ha) of heavily contaminated by mines and cluster munition territory (from the present figure 4 DOK-ING MV-10 Heavy-Duty EOD Robotic Systems and 5 MV-4 Multi-Mission EOD Robotic Systems operated by SESU demined 3 016 562 m^2 (over 301,6 ha), which represents 62,83% of all cleared area).

Moreover, in some cases, machines act as psychological tools. Some of the operators admit that they are considering using locally produced “roller” systems as a method for verifying land that has shown no evidence of ERW contamination, but farmers are reluctant to cultivate that land. The rollers — which are not a clearance system and should not be confused with those systems that are designed for clearance — will aim to cover a designated ground to verify there is no ERW present, which will allow farmers to return their land to full productive use. The use of the rollers has the potential to

[20] International Mine Action Standard 09.50 — Mechanical Demining.

[21] https://www.gichd.org/fileadmin/user_upload/GICHD_Difficult_Terrain_A5_10_WEB.pdf

[22] “Order on the method for performing demining operations, quality control, general and technical inspection and the marking of suspected mine areas,” Croatian Ministry of the Interior, May 5, 2016, Article 29, available in Croatian (“Pravilnik o načinu obavljanja poslova razminiranja, kontrole kvalitete, općeg i tehničkog izvida i obilježavanja minski sumnjivog područja”), accessed December 16, 2022, https://narodne-novine.nn.hr/clanci/sluzbeni/2016_05_45_1164.html.

unlock large areas of land that are currently unused because of the perception of contamination. We should, however, keep in mind a residual risk behind rollers' use, especially while they are pushed by underpowered basic vehicles (prime mover) in dense vegetation or operate on wet ground. In the first instance, it may stop rollers from operating or lead toward rollers missing some explosive targets. In the second scenario, there is a strong chance that rollers will push small AP mines or cluster munitions down into wet ground without activating them.

The noticeable 'fashion' for the kind of mechanized demining machines that all Ukrainian operators are seeking[23], nevertheless, should be strictly adjusted to specific tasks and areas where operators work. All of the requests should be verified accordingly, otherwise, it will be an inefficient allocation of scarce financial resources available for demining.

Naturally, high demand for demining machines and robotic systems has created a respective surge in interest by world manufacturers to provide Ukraine with their products. GLOBSEC has identified a number of them already working or considering working in Ukraine to meet the growing needs. Some of them have also started to look for local partners to establish different forms of cooperation. Yet, the following considerations should be taken into account while assessing the efficiency of these processes:

1. manufacturing capacity to produce each item and the number of products available for Ukraine in a year;
2. dependence on assembly parts from other manufacturers (especially located in other countries);
3. pre-order terms for assembly parts and time of delivery;
4. maintenance and repair facilities in Ukraine; spare parts availability;
5. capacity to exchange a broken product; time of interruption of services;
6. technical complexity of operations;
7. teams of engineers and operators in Ukraine;
8. training opportunities and time to train Ukrainian teams of operators, engineers and mechanics.

Availability of machines supplied to Ukraine presents a relative challenge as most OEMs (Original Equipment Manufacturer), with some exceptions, do not keep in stock more than a couple of sets of major components and parts for their final assembly due to financial burden. Therefore, an understanding of the real **capacity of producers to manufacture a demining machine** in a certain period is of crucial importance. To respond to the requests from Ukraine OEMs would need to **prepare production plans** and respectively request their partners to **supply assembly parts** for manufacturing. On average it might take from 4 to 12 months for assembly parts to be supplied for which a main producer needs to make advance payments. Without full and clear commitments from a customer (which is the Government of Ukraine in our case) with set-up quantities and financial terms (like state guarantees) it becomes very challenging for a manufacturer to plan his production cycle accordingly. In this regard, more advanced government planning and clear target setting as to the number of machines of a specific type, source of finance (state budget of Ukraine, private donations or international donor pledges) and centralized indication of end-users among the state operators seems to be highly advisable.

Other considerations should be given to thorough examination of the **working conditions of machines** already supplied to Ukraine. To our knowledge, some of the items delivered are in poor working conditions or broken either because of the mishandling, mismanagement, absence of trained team leaders, properly organized logistics (i.e. storage conditions, equipped workshops for machines' preventive and corrective service, etc.) or due to manufacturing defects. Some of them are supplied with minimal spare parts and consumables (SPC) packages to reduce the price of a machine so that in the case of a breakage it cannot be replaced timely. This affects real statistics of the actually operating demining machines in Ukraine. Therefore, **maintenance terms and the existence of repair facilities** in geographical proximity to Ukraine (ideally, inside Ukraine itself) are of crucial importance and should be taken into consideration while analyzing the cost-benefit ratio.

The technical complexity of operations, human safety (whether it is on-site or remotely operated) and **trainings of engineer teams and mechanics** will impact the efficiency of performance too. Very complicated and clumsy equipment, a limited number of engineers and mechanical staff (eg. one maintenance team), lack of training facilities inside Ukraine might severely impede demining works in case an expensive sophisticated machine is broken

[23] With international operators we can detect more moderate appetite to consider machines as additional tool, which is more adjusted to reasonable needs.

due to mishandling, a member of a maintenance team is out or other force-majeures.

The GLOBSEC team has collected the available information about different manufacturers, which is presented in the ANNEX I.

XII. USAGE OF MINE DETECTION DOGS (MDD) IN HUMANITARIAN DEMINING

MDDs proved to be rather effective internationally in countries with similar climates and terrain as Ukraine[24], and their usage in Ukraine will be efficient for HD as they can detect up to 8 different types of explosives. 2 MDDs can cover 300–5000 sq m per day compared to 2 deminers, which can survey altogether only up to 50 sq m per day. Thus, the use of dogs could speed up humanitarian demining productivity tenfold. After a few days when the area is initially cleared by mechanical demining equipment, one team of MDDs (2 x dogs) can cover up to 1500 sq m per day behind it, when vegetation is removed and the scent of diesel fuel and oil after machines has dispersed. MDDs can also be effectively used in TS to reduce SHA[25]. The best breeds for the job of an MDD are German Shepherds, Belgian Shepherds (Malinois), Labradors, and Cocker Spaniels. Yet, certain climate conditions like very cold, rainy, windy weather or heat, ground wind up to 7m/sec, or dense vegetation over 15 cm can prevent MDDs from working.

As of early spring 2023, Ukraine was not using MDD at a large scale[26]. This was explained by the fact that no standard operating procedures were in existence and national accreditation authorities were reluctant to use dogs for humanitarian demining without a special protocol and respective regulations. Since that time the situation has changed significantly, mostly owing to EU assistance and the efforts of the NPA (Norwegian People's Aid) already deployed in Ukraine, which is considered to be among the top MDD breeders, trainers, and end-users of MDDs.

In April and November 2023, the EUMAM delivered altogether 18 MDDs to Ukraine within the framework of the ongoing EU project to supply 50 MDDs in 2023-2024[27]. In April 2023, NPA delivered a total of 14 MDDs to Ukraine, with six designated for the State Emergency Service of Ukraine and eight allocated for NPA operations. Training for the dogs and their handlers, conducted jointly at SESU's Interregional Rapid Response Center in Romny, took place from May to August. The joint training was delivered by NPA's MDD technical advisor and an MDD technical field manager, with support from a trainer from NPA's Global Training Centre (GTC) for detection dogs in Bosnia and Herzegovina. SESU obtained MDD accreditation in early October and immediately began deploying the dogs. In November 2023, NPA became the first organisation in Ukraine to obtain accreditation for using MDDs for demining operations. NPA is currently finalizing the necessary infrastructure to deploy the dogs in operational areas in Mykolaiv region. Howard Buffett's Charitable Foundation sent 11 service dogs to the Canine Center of the Kyiv Region Police, who will help search for explosives and other operations.

XIII. GETTING LOCAL: MACHINES PRODUCTION AND INNOVATIONS, IT SOLUTIONS AND AI, CIVIL SOCIETY ACTIVISTS

Activities observed in the demining of Ukraine in 2023 give the impression that Ukrainian society has not been left untouched by the importance and scale of the task. The responsible and very proactive approach of the Government of Ukraine worked in parallel with big industrial and agricultural holdings' initiatives to support HD. That period also saw a surge of different civil society formations with a focus on demining. Several local manufacturers echoed the calls from the Government 'to go local' in the production of machines for mechanized demining and began to invent new prototypes. Plenty of innovative IT and AI ideas for demining have been channeled through Brave 1[28] initiative to support start-ups.

These encouraging trends of 'collective responsibility' of the country to address the challenge, nevertheless, contain certain hidden traps that should be considered and avoided by proper policy-making.

---

24 Croatia, Bosnia & Herzegovina, Cambodia, Afghanistan are good examples.

25 No dogs have been used after manual deminers in Croatia because manual demining was considered to be the major and single accepted method by the Law of HMA in the country.

26 For example, Norwegian Refugee Council has 16 MDDs and SESU — 8.

27 https://home-affairs.ec.europa.eu/news/eu-trained-dogs-help-ukrainian-armed-forces-demine-country-2023-11-14_en; https://rubryka.com/en/2023/04/01/pomichnyky-dlya-patrona-do-ukrayiny-prybuly-z-niderlandiv-11-sobak-saperiv/

28 United coordinational platform created by the Government of Ukraine to promote collaboration between all stakeholders of the defense tech industry by providing them with organizational, informational, and financial support for defense tech projects in Ukraine.

▶ Local Production of Machines, Joint Ventures and Other Forms of Cooperation with OEMs

The Government of Ukraine is encouraging local manufacturers to consider ways of developing their production of demining machines, to set up joint ventures and/or to get engaged in other forms of cooperation with international OEMs to boost supply on the market. The benefits of this approach are obvious as it enables the revival of SME activity, creates new jobs, integrates into international supply chains, provides more taxes to the budget and minimizes geographical proximity to end users.

This focus on reinforced manufacturing in Ukraine is also strategically justifiable, as, in perspective, this could lay the foundations for a revival of heavy engineering industry and these production facilities can be located in Kramatorsk and other industrial centres of Donetsk and Zaporizhzhia regions.

There are a number of Ukrainian manufacturers who try to produce demining machines themselves. Also, in June 2023 a shipping company "Nibulon" (Mykolaiv, Ukraine) started to build vessels designed for demining works to expand this fleet to fifteen. In order to improve the quality and technological capacity of these machines, local producers import a lot of assembly parts from abroad. An underlying challenge has been detected that significantly affects these efforts of the local manufacturers: payments of value-added tax (VAT) often coincide with other financial costs for a manufacturer (advance payment of first instalment and import of assembly parts), whereas a contract execution as such and supply of assembled machines (with final settlement over a contract) happens approximately six months later. Besides, VAT increases the overall cost of a machine, thus, making it less competitive and financially sustainable for a manufacturer in Ukraine. A solution might be seen in considering a temporary (for the time of martial law and, possibly, over the next 10 years) VAT and customs duties' exemption for imported assembly parts (materials, technical units, sub-units, equipment and components) that are imported by manufacturing companies to produce/repair demining machines. To prevent misuse of the imported parts, a technological scheme of a production/assembling process could be requested for submission (with due respect to commercial non-disclosure terms and intellectual property rights). This suggestion is based on the positive example of VAT and customs duties' exemption on imported goods and assembly parts used in the production/repair of unmanned aerial systems, radio- and electronic warfare means, radiolocation complexes and armoured plates for armed vests that Ukraine approved some time ago.

The Ministry of Economy reports successful cases of international cooperation activities and localization of production in Ukraine with reference to **two Memoranda** signed with Ukraine by the Croatian company "DOK-ING" and the Danish company "HYDREMA", as well as local production of machines that prepare the soil for demining purposes in the Kharkiv region. The latter has already received **a certificate** of conformity and a declaration of conformity, which allows it to establish its production and use it for demining territories. There are also negotiations with France on localizing their production in Ukraine. Among the main challenges, the Government defines a lack of proper manufacturing capacities in Ukraine to produce machines and assembly parts, as well as less advanced technologies, so the option of ordering equipment from abroad remains very attractive. However, in perspective, the intention is to substantially increase localized production components.

▶ Testing of Local Inventions

The current period is being characterized by a splash of different initiatives of the private sector, and IT start-ups to invent the most efficient technologies for demining and to apply them in Ukraine. The Government of Ukraine encourages these efforts and supports them. One of the examples is **a KSE HD Accelerator program** developed together with the Ministry of Economy of Ukraine to support innovations in humanitarian demining aimed at the implementation of new solutions to certified products and technologies. The program comprises technological, commercial and funding components. It envisages training courses on entrepreneurship, mentor support from sectoral experts, and testing of technologies in real-time. The participants in the program will have a chance to build an individual action plan with the assistance of mentors and experts and receive support to construct a business model and a business development plan from an idea/prototype to a certified product/technology.

On 2-3 December a two-day **Demining Bootcamp** took place in Kyiv, where around 30 teams that aspire to participate in the aforementioned innovations support program, were able to present their projects under categories of (1) demining equipment; (2) complex solutions; (3) IT-solutions; (4) surveys. A commission comprising the National Mine Authority, the Ministry of Defence, SESU and the Ministry of Economy accessed presentations and gave its feedback.

The Brave 1 platform, which has defined demining as one of its priority clusters, has already registered around 20 innovative solutions with seven of them receiving nine grants amounting to USD 145,000.

These solutions are grouped into 4 main categories: (1) detection and identification; (2) robotic systems; (3) mechanical demining; (4) other innovative solutions with the following breakdown:

- detection and identification: sensor-based devices to detect metallic objects, chemical components and other explosive materials;
- robotic systems: automatic robots for demining;
- information systems: software and mobile applications for coordination of demining teams, data fusion, analysis and visualization of information;
- mechanisms and devices: special equipment for physical extraction or neutralization of explosive ordnance;
- other innovative solutions: eg. methods with specific technologies or materials for detection and neutralization of explosive ordnance.

This proactive attitude to solutions deserves to be welcomed. At the same time, a cautious approach should be taken when it comes to testing, as the rules on the use of products/technologies, quality control and qualification are of utmost importance and should be conducted in a proper set of internationally recognized standards. Every single newly invented remote tractor or other machine has to be fully tested and evaluated, as per IMAS 09.50/01/2009 Test and Evaluation Protocol of 30/06/2009. Given several emerging initiatives and provided a respective testing ground in Ukraine is in place[29], this will put a huge unnecessary burden on future Ukrainian testing centres in Chernihiv and Merefa making them overloaded and less focused on their other activities. Testing authorities of MOD and SESU/MOI could end up with a necessity to test annually a few hundred machines/technologies. We recommend that no prototypes invented locally such as tractors/machines with adjacent IT technologies/use of drones with no global international activity records should be easily qualified in UA, otherwise, it can get challenging to guarantee the quality of the work of HD.

▶ Scaling the Opportunities for Operators, the Market for Demining, Dark Deminers

The establishment of the competitive market for humanitarian demining was defined as of one the priorities by the Government of Ukraine. The solution is seen in the vigorous development of service purchases through price reduction auctions, where both national and international operators can participate. The pilot tender for the demining of 3 ha of forest in the Zhytomyr region was successfully conducted on the Prozorro System in summer 2023. The winner offered a price of 100,000 UAH lower than the starting price.

While **acknowledging** that the market has not been formed yet, the Government is confident that this approach will yield results. The aim that is set is to help small farmers get these services at fair prices through competition among certified operators. Small farmers, who cannot afford to pay for demining services, are likely to receive compensation from the state. Helping a farmer to receive such a service would potentially mitigate a problem of 'dark deminers' when a farmer had to resort to a very cheap service because market one was affordable.

First impressions of the initiative from the operators have been very positive, but it is still very difficult for them to understand how to make this business sustainable and where to look for financial support to expand their capacities. **3 bln UAH** in the State Budget 2024 is supposed to give a share of activity to private operators, who will be motivated to produce results which might produce new contracts for their services. At the same time, big agrarian holdings are also interested in investing in the demining of their territories in exchange for future compensation for these costs and/or by obtaining cheap loans under special programs. Currently, different arrangements are being considered by respective decision-makers and there are likely to be some initiatives forthcoming in the next few months.

▶ Civil Societies' Activity

Given the surge of many new civil society groups, NGOs, trade unions, charitable foundations and organizations with a focus on humanitarian demining, we can justifiably say that this issue has definitely become a 'fashion' in Ukraine. GLOBSEC has counted as many as 21 different groups and non-profit organizations, with 13 of them created in 2023 alone. Most of them do not even have proper websites or other outlets for their information. From our communications with quite a few of the newly established structures we see that many of them have a very vague understanding of what demining actually means. That drives us to the conclusion that many NGOs have been created in anticipation of the incoming flow of money from international donors to Ukraine that might easily be obtained for demining activities. Without any prejudice, we would like to stress that, whilst welcoming

[29] For the time being there is no one in Ukraine, however, the Government is working on setting it up in Spring 2024.

the engagement of different civil society groups into discussions on humanitarian demining, there should be particular scrutiny concerning the track records of these organizations and the qualifications of their personnel, at least as far as their understanding of the nature of demining and mine action, in general, is concerned, not to say their technical expertise to assess the situation and to make expert comments.

Non-Profit Organizations in Ukraine with the Focus on Demining*

N°	Name	Date of Registration
1	NGO Union of Soldiers-Internationalists, Peacekeepers, Deminer Experts, Participants of War, Children of War, Veterans of the Armed Forces of Ukraine	05.05.2014
2	Trade Union of Participants of Demining Works	27.06.2018
3	Ukrainian Deminers Association (UDA)	15.11.2018
4	Non-Governmental Organization World Demining Group (NGO World Demining Group)	23.01.2019
5	NGO Ukrainian Demining Group (UDG)	03.02.2020
6	NGO Demining Control (DC)	30.12.2022
7	Charitable Organization Charitable Foundation Ukrainian Demining Foundation (CO CF UDF)	21.10.2022
8	Charity Organization International Charity Foundation Patron Demining (CO ICF Patron Demining)	02.12.2022
9	Charitable Organization Charitable Foundation Demining Control (CO CF Demining Control)	28.12.2023
10	Association «Ukrainian National Humanitarian Demining Association» (Association «UNHDA»)	17.11.2023
11	Charitable Organization Charity Fond Demining of Ukraine (CF Demining of Ukraine)	21.04.2023
12	Ukrainian Association of Humanitarian Demining Operators	23.08.2023
13	Charitable Organization Charity Foundation Scientific and Research Center of Remote Sensing and Demining Technologies Dropla (CO CF Scientific and Research Center of Remote Sensing and Demining Technologies Dropla)	28.06.2023
14	Ukrainian Association of Humanitarian Demining (UAHD)	01.08.2023
15	Public Organization Ukrainian Center for Humanitarian Underwater Demining	18.08.2023
16	NGO Demining and Rehabilitation	08.06.2023
17	Safe Way: Association of Demining Professionals in the Territory of Ukraine	02.06.2023
18	Humanitarian Demining Fund-Irpin (HDF-Irpin)	25.01.2023
19	Primary Trade Union of Sappers (Deminers) of HALO Trust Representation Office in Ukraine	14.06.2023
20	Charitable Organization Charitable Fund Demining of Slobozhanchyna (CO CFDS)	01.06.2023
21	Ukrainian Center for Mine Action Strategies (UMAS Center)	03.05.2023

Source: https://youcontrol.com.ua/; search conducted under 'demining' as a keyword

XIV. BIG DATA TO COPE WITH BIG CHALLENGES

For data collection on explosive ordnance identified, areas surveyed, and ongoing risk education activities Ukraine uses IMSMA Core, installed by the GICHD, which is receiving new information daily. IMSMA has a lot of merit for collecting demining data that adheres to specific international standards. It is an industry-standard for data collection and provides the "golden set" of accredited demining information. However, to adequately prioritise, it needs to be combined with information about the utility of the land that is being contaminated — and also, there is still some information in data that may not meet the standards to be inside IMSMA (e.g. civilian reports, drone imagery results). The IMSMA data is the gold standard of information on confirmed and suspected mined areas, but there is much that needs to be added properly and adequately to build a notion of "risk" informed by a complete picture.

Ukraine faces an unprecedented humanitarian demining challenge. To begin reconstruction and clear the country in years instead of decades, it is essential to further develop innovative approaches to land release, region prioritization and risk management.

The Government of Ukraine is pioneering collaboration across public organisations and private enterprises to innovate in the field of mine action. For example, SESU is trialling remote UAV land surveys with UNDP, and the Ministry of Economy is building an Information Management and AI system with Palantir Technologies.

Effective information management will be a key thread in the effort to realise operational outcomes from these innovative processes. It is essential for decision-makers at every level to have access to clear and coherent data to build a complete picture of the risks and land use. It will be the ability to combine potential risk (what is the likelihood of a hazard being present?), with opportunity cost (what is this land being used for?) that will establish priority.

This must broaden the remit of existing information management systems, those that are built for specific processes and standards. Rather, Ukraine will need to combine vast data sources across government, public, private, and commercial sectors. Beyond simple data collection, this asset must be effectively and continuously analysed to adequately prioritise demining operations and manage risks. The results of such analysis must form an operational part of the coordination of operators.

To accomplish a reliable repository of information that is distributed across the government, the focus should be made on:

1. Accurate determination of land contamination and use status

    a. What is the likelihood of contamination? What is the severity of likely contamination? Connecting surveys and data sources from every relevant provider (private, public, or third sector organisation) to establish potential hazard locations, the impact of the hazard on the use of land, and the importance of the land on surrounding infrastructure.

    b. Is this land currently being used? Proactively identifying the status of land use will help Ukraine come to an understanding of the "extent" of the problem and allow operators to reach critical sites quickly.

2. Being able to provide estimations on key KPIs of land release.

    a. Providing measures of metrics like "time to demine" and "value of land unlocked" — providing the ability for people to plan around reopening and estimate the impact on the economy.

    b. Focusing on infrastructure to report and measure the KPIs that will outline and monitor the effectiveness of Ukraine's demining strategy.

3. Establishing open data standards for information sharing among operators

    a. Information needs to be securely shared across all actors in the humanitarian demining space.

    b. There should be a common risk operating picture across government and relevant stakeholders.

It is important that any system introduced remains compatible with existing standards and is simple enough to be used by operators of all technical abilities. Furthermore, any such system should come with strict guidance on data governance requirements such that information is shared on a need-to-know basis.

XV. GOVERNMENT ACTION

In February 2023 some scepticism was expressed around the new initiative of the Government of Ukraine to establish the **Interagency Working Group on Humanitarian Demining (IAWGHD),** chaired by the First Vice-Prime Minister-Minister of Economy. Alongside the existing structure of the **National Mine Action Authority (NMAA),** the IAWGHD is comprised of almost the same governmental institutions of Ukraine as the NMAA[30]. In April 2023 GLOBSEC wrote *'The division of responsibilities of the various institutions responsible for demining is unclear as is the answer to the question 'who retains overall responsibility?' making the environment highly competitive and potentially open to conflict.'* At the same time, we noted that the status of the First Vice-Prime Minister is superior to that of the Minister for Defence, who chairs NMAA in war times[31], thus, some of the functions of IAWGHD would be different. The tasks of the IAWGHD were set up to define priorities and organize the work of

[30] Ministry of Temporarily Occupied Territories, Ministry of Digital Transformation, Ministry of Development of Communities and Territories, Ministry of Interior, Ministry of Foreign Affairs, Ministry of Agriculture, Ministry of Defence, SESU, State Agency of Reconstruction and Development of Infrastructure, State GeoCadastr, National Security and Defence Council of Ukraine.

[31] It is expected that once Ukraine restores territorial integrity within its internationally recognized borders, the head of the ministry responsible for formulating and implementing the state policy in civil protection and emergency response (currently the Ministry of Interior-SESU) will replace the MOD as the lead body in NAMAA.

humanitarian demining required for reconstruction and resumed economic activity, as well as to come up with respective policy proposals.

Over 2023 experience proved that the existence of multiple bodies with almost similar tasks could be organized in rather a collaborative manner. Despite some remaining confusion — especially, among international partners — about 'who is responsible for what?' it seems clear that communication channels have been streamlined and are working well.

IAWGHD (namely, the Ministry of Economy) with the help of UNDP and GICHD initiated vigorous efforts to develop strategic initiatives at the governmental level, revise national legislation, set up communications with international donors, draft the Mine Action Strategy and make efforts to calculate and prioritize areas for demining to resume social and economic activity on the liberated areas as soon as possible.

To date, they have a good track record to report on. Amongst others, the **Demine Ukraine Forum** in September, the establishment of the Center for Humanitarian Demining[32] with an international steering board[33], a draft Mine Action Strategy developed in a stunningly inclusive and transparent manner[34] and regular (over 10) meetings of the IAWGHD with meaningful discussion of current challenges and suggested solutions[35].

As a result of the legislative review process the Ministry of Economy has acknowledged that the existing regulatory base requires substantial improvement. In 2024 this review should lead to further simplification of the certification procedures and making them digital. Other initiatives include proposals to amend the existing Mine Action Law, upgrade standardization procedures to include streamlined certification of operators, and procedures, introduce standards for mechanized demining and other tools (MDDs, remote survey), a harmonized system of training aligned with those existing in partner countries and many more.

Against the background of this generally positive picture of the proactive and creative approach of the Government of Ukraine, there are still some issues, which require further improvement. The established Sectoral Working Group on Humanitarian Demining (SWGHD), co-chaired by the First Vice Prime Minister of Ukraine Ms Yuliia Svyrydenko, Ambassador Extraordinary and Plenipotentiary of Japan to Ukraine Mr Kuninori Matsuda, UN Resident and Humanitarian Coordinator Ms Denise Braun, has formed a rather impressive group of representatives from over forty partner-countries. One of the existing challenges is to make the process of needs assessments, requests and donor commitments more aligned and visible, as previous practice enabled different state operators to reach donors directly and to ask for assistance to meet specific needs. The Government is still struggling to see the whole picture of needs/requests-commitments/pledges and to adjust it where required. The **representation level** of SWGHD is very broad ranging from very high ranks (Ambassadors) to the level of attaches/specialists from different embassies of partner countries. As discussions at SWGHD show, sometimes these people (especially lower level) are not necessarily aware of their respective governments' recent measures and policy lines in HD and cannot respond professionally without proper clarification of an issue with their ministries and governmental offices back in their countries. This process consumes a lot of time and proved not to be productive. Consideration should be given to another backchannel at the political level within the governments of partner countries to speed decision-making. Also, it would greatly help to make a full and comprehensive inventory of full needs/requests-commitments/pledges submitted by individual state operators to donors directly.

XVI. INTERNATIONAL ASSISTANCE AND COOPERATION

Over 2023 activities in this realm also were substantially solidified, which demonstrated the resolution of the consolidated international community to help Ukraine comprehensively tackle humanitarian demining. The scope of work includes HD itself, training, victims' assistance and EORE (especially with

[32] Main tasks of the Center are to gather information, strategic planning, coordination of processes and international cooperation.

[33] Members of the steering board include the American investor and philanthropist Mr Howard Buffett, Director of the EU Foreign Policy Instrument Service Mr Peter Wagner, Head of Operations of Croatian Mine Action Center Mr Davor Laura, Ambassador Extraordinary and Plenipotentiary of Japan to Ukraine Mr Kuninori Matsuda and other.

[34] With GICHD and UNPD the Ministry of Economy organised a kick-off workshop on the Mine Action Strategy in October 2023, to which it invited over 60 representatives of national and international operators, national NGOs and public associations, expert community and government representatives. The results of the workshop in a form of initial draft and key findings were presented to diplomatic community of the international partners on a concluding session.

[35] As results of such meetings some regulatory restrictions that significantly limited activities of internationally certified operators were simplified and streamlined. For instance, simplified regulations to obtain permission for explosive works during humanitarian demining and the usage of explosive materials by operators in times of the martial law. Also new procedures on international certificate recognition and their compliance with national requirements have been considered and recommended to be adopted.

children), donations and donor pledges of in-kind and financial support. However, a major part of the donors' assistance still goes to support the activities of big international operators working in Ukraine with a lesser amount retained for equipment purchase for Ukrainian state operators.

The International Donor Conference on Humanitarian Demining organized by the Croatian Government on 11-12 October 2023 raised about **500 mln** EUR in commitments by different states and international organizations. These figures match the World Bank's **assessments** of around 397 mln USD for 2023 only, but there is still a challenge to reach the annual desirable target of 3,74 bln USD annually for the next ten years. A follow-up donor conference announced by Switzerland for 2024 is expected to see more commitments and streamlined processes of assistance.

Some of the figures of the known financial commitments by the end of 2023 are given below.

- **100 million** EUR from Switzerland
- **18,5 million** EUR from Norway
- 12.5 million EUR from Sweden
- 5 million EUR from Croatia
- 2 million EUR from Austria
- 1.5 million EUR each from Spain and **Slovenia**.
- **10 million** USD from the Netherlands (supported by UNDP)

The EU and its member states together are providing more than **110 million EUR** to support humanitarian demining in Ukraine. This includes more than EUR 35 million of ongoing support financed through EU rapid response and humanitarian assistance.

With a view of the challenges described in the section above, an **initiative** by the Lithuanian Government to establish a demining coalition among the partner countries for Ukraine is seen as a potentially important and influential mechanism to support the HD activities of the international donor community. While the main focus of the coalition is placed on the 'train and equip' principle, it could also help politically. 22 countries have already expressed interest in joining the coalition. More developments will follow with meetings of partner countries planned in January 2024 and further.

Joint efforts of NATO Black Sea littoral states of Romania, Bulgaria and Turkey to form a **Mine-Sweeping Force** to Clear the Black Sea Route are also seen as having the potential for cooperation with Ukraine. The Government of Ukraine has already expressed its interest in considering options for coordinated efforts.

POLICY RECOMMENDATIONS[36]

1. To envisage a system of periodical or ad-hoc checking of cleared territories after air strikes if a cleared zone was attacked by missiles, as well as to align it with a system of rapid response and control by competent authorities.

2. To consider the allocation of more resources to conduct work on NTS to cancel as much land as possible in 2024 (within the given accessible zones) and to come up with more realistic figures of suspected hazardous areas (SHA) and confirmed hazardous areas (CHA) in Ukraine.

3. To consider expansion of EORE programs to include as much of the population of Ukraine as possible (with special emphasis on children, farmers and residents of rural areas).

4. To develop plans to conduct an initial special assessment of soil contamination. To consider options of making this assessment before any EO clearance is conducted. The suggested soil contamination assessment should not be a detailed and specific one. It would be enough to identify major heavy metals and/or oil products and their concentration level with the help of a portable mass spectrometer.

5. Together with international partners consider setting up a special laboratory in Ukraine where such a soil analysis could be done.

6. To plan actions for the identification and categorisation of territories/land subject to conservation, decontamination (from particular pollutants), re-profiling of its usage or immediate release.

7. To assess possible costs for zoning and restoration of the land. To start planning (together with international partners) necessary works required to restore the fertility and quality of agricultural land in Ukraine.

8. To generate international assistance for the rehabilitation of the ruined ecosystems and to create, at least, new 10 contemporary natural parks and 10 rehabilitation centres for wildlife species and to monitor the restoration of biodiversity.

9. To make a coherent assessment of existing/expected numbers of deminers and to match these with existing/pledged personal protection kits and equipment tool kits. To adjust expectations based on equipment available/committed.

10. To consider training of training schemes (with the participation of international partners and trainings conducted in their countries) to be used on a wider scale to train deminers in Ukraine.

11. To develop opportunities for training of operators of mechanized demining and MDDs' handlers (with a focus on expanding these facilities in Ukraine).

12. To invest more in financial, human and material (equipment and modern technologies) for the development of Ukraine's capacity in underwater demining. To expand opportunities for more trainings (both in Ukraine and advanced diving schools of littoral states).

13. To consider possibilities of Ukraine's participation/cooperation in joint efforts of NATO Black Sea littoral states of Romania, Bulgaria and Turkey to form a **Mine-Sweeping Force** to clear the Black Sea Route.

14. To adjust requirements/needs for mechanized demining machines to specific tasks and areas where operators requesting them work. To verify matching needs accordingly.

15. To continue the improvement of the certification of operators with more digitalisation of procedures to make all those processes transparent and to reduce the potential impact of the human factor.

16. To develop an efficient security mechanism to verify and analyse terms of OEMs offer of demining machines and robotic systems to Ukraine in order to ensure the most efficient purchases matching the needs of end users in Ukraine. This mechanism should include parameters like: (1) availability of machines supplied to Ukraine; (2) capacity of producers to manufacture demining machines per quarter; (3) time of delivery; (4) spare parts and consumables (SPC)

[36] We do not put here those recommendations on major initiatives that the Government of Ukraine is already working on, like, for instance, Mine Action Strategy or international partnerships for localised production. Instead, we focused on issues that have not been much in public discussions but identified in course of the research.

packages; (5) service and maintenance terms; (6) existence of repair facilities in geographical proximity to Ukraine (in Ukraine); (7) local support teams and partners and other. This mechanism should also envisage checking and reporting (based upon information submitted by end-users to the Sectoral Working Group on Humanitarian Demining) on the working conditions of the supplied machines and their operation status at regular intervals.

17. To set up an advanced government planning and clear target setting as to the number of machines of a specific type, source of finance (state budget of Ukraine, private donations or international donor pledges) and centralized indication of end-users among the state operators, in order to ensure consistency of supplies and to enable OEMs to develop production plans to meet Ukraine's needs.

18. To consider a temporary (for the time of martial law and, possibly, over the next 10 years) VAT and customs duties' exemption for imported assembly parts (materials, technical units, sub-units, equipment and components) that are imported by manufacturing companies in Ukraine to produce/repair demining machines. In this regard to consider necessary amendments to draft laws N°N° **10219** and **10220**.

19. To ensure proper testing and conformity assessment of all the prototypes invented locally such as tractors/machines with adjacent IT technologies/use of drones with no global international activity records, which should be based on IMAS 09.50/01/2009 Test and Evaluation Protocol of 30/06/2009.

20. To accomplish a reliable repository of information (based on IMSMA Core, but going wider) that is distributed across the government to streamline big data processing in HD. To ensure that any system introduced remains compatible with existing standards and is simple enough to be used by operators of all technical abilities. Such a system should come with strict guidance on data governance requirements. The focus should be made on: (1) accurate determination of land contamination and use status; (2) estimations on key KPIs of land release; and (3) establishing open data standards for information sharing among operators.

21. To make the process of needs assessments, requests and donor commitments more aligned and visible, and to ensure a 'one-window' channel to gather requests of needs of different state operators and donor responses to get a comprehensive picture of all needs and donor commitments on the level 'Donors-State'. For this to improve information flows between representatives of partner countries in the Sectoral Working Group on Humanitarian Demining and their respective capitals.

22. To consider the Lithuanian government's initiative on HD Coalition to act as a leverage tool to support the tasks of the recommendation above.

ANNEX I

Comparative table on different manufacturers of demining equipment in the world, that can be available for Ukraine

Manufacturer/ machine type	Type of operations and Capacity (sq m per hour, clearance depth)	Stock in Ukraine already (in use by operators) / planned supplies	Price and maintenance costs	Production capacity availability for Ukraine	Logistics and delivery time	Service/ maintenance in Ukraine	Spare parts supply	Presence in Ukraine (representation office, local partner, joint ventures)
Armtrac Ltd (UK)*	**Armtrac 400** (a tiller and flail) equire 3,000 sq m/ hour fully remote-controlled Max working depth 35 cm **Armtrac 20T** C-IED Robotic system (EO clearance) fitted with various toolkits, including a demining flail or tiller and a rear robotic arm with different attachments[1]. Digging tiller depth 200 mm Max.	1x ARMTRAC-400 (SESU, Kharkiv)/ plans to purchase further Armtrac 400s over the next few months. 1x Armtrac A20T with rotary mine comb (HALO Trust)	n/a	n/a	n/a	Field support. 12-month warranty with Factory follow-up Manuals and documentation are part of the purchase package Maintenance training for an operator/mechanic. Engine servicing: after 250 – 1000 engines/ hours. Daily servicing: checks on consumable items such as picks and hammers on demining toolkits such as Flail and Tillers.	12 months spares package	Representative office in Ukraine
Way Industry – Bozena (Slovakia)	Bozena 4+ Light soil / small vegetation up to 3,500 sqm/h Medium soil and vegetation up to 2,100 sqm/h Heavy soil / dense vegetation up to 1,100 sqm/h	11 machines (8 delivered by Slovakia, 3 from the Netherlands plus some unknown number from Poland). Planned supplies:	Bozena 4+ vary from 300.000.-€ Bozena 5+ vary from 500.000.-€ Maintenance cost : about 10% of the total value of a machine	total annual production – 96 units annually (not specified allocation for Ukraine)	6 months first 8 units, further 8 units per 1 month (4 pcs Božena 5+, and 4 pcs Božena 4+)	performed by an authorized service partner in Ukraine KZVV (“PrJSTC “KRAMATORSK HEAVY DUTY MACHINE TOOL BUILDING PLANT”)	available through an authorized service partner in Ukraine KZVV (“PrJSTC “KRAMATORSK HEAVY DUTY MACHINE TOOL BUILDING PLANT”)	service partner in Ukraine KZVV (“PrJSTC “KRAMATORSK HEAVY DUTY MACHINE TOOL BUILDING PLANT”)

[1] In C-IED operations, a detector system can be mounted on the front of the vehicle, and an IED disruptor can be fitted on the rear robotic arm. A 74 HP diesel powers its water-cooled Kohler engine and can operate for several hours on demining operations continuously without refuelling. All hydraulic hoses and couplings on the vehicle are internationally standard, making it easy to maintain and repair.

Manufacturer/ machine type	Type of operations and Capacity (sq m per hour, clearance depth)	Stock in Ukraine already (in use by operators) / planned supplies	Price and maintenance costs	Production capacity availability for Ukraine	Logistics and delivery time	Service/ maintenance in Ukraine	Spare parts supply	Presence in Ukraine (representation office, local partner, joint ventures)
	Flail, Tiller depth up to 25 cm Bozena 5+ Light soil / small vegetation up to 5,900 sqm/h Medium soil and vegetation up to 3,400 sqm/h Heavy soil / dense vegetation up to 1,500 sqm/h Flail up to 30 cm, Tiller up to 35 cm in depth	First Q 2024: 8 machines (6 pcs of Bozena 5+ 2 pcs of Božena 4+) Second Q 2024: 2 pcs of Bozena 5+						
DOK-ING d.o.o. (Croatia)	MV-4 – 23.5 – 25 cm depth, 1700-2000 m^2/Hr (average based on 9 x MV-4s officially tested by CROMAC-CTRO) MV-10 – 30 cm depth, 3200-3800 m^2/Hr (average based on 12 x MV-10s officially tested by CROMAC-CTRO)	12× units deployed: 5× MV-4, 4 x MV-10 (SESU), 1 x MV-10 (NPA), 1 x MV-4, 1 x MV-10 (FSD) 14× extra units by Dec 23: 3 x MV-4 (Swedish MOD to AF of UKR), 5 + 5 x MV-4/MV-10 (SESU), 1× MV-10 (DSST). Q1 2024: 2 x MV-4 (Korean Army to MOU), 2× MV-4 (Irish MOD to AF of UKR)	Price varies, depending on each machine's configuration.	Production capacity for Ukraine: if informed in advance (commitment), DOK-ING can supply about 50 units in 2024 and about 70 units in 2025. Current book of orders for 2024: 11× MV-10.	4 months (from order placement); 5-7 days[2] – delivery time from DOK-ING facilities in Zagreb to any place in Ukraine (subject to the Romanian Export License availability). Provision of trailers to transport demining machines. Supply of towing trucks is optional	Ground preparation, mechanical mine clearance, technical survey, comprehensive training of complete mech. crews, refreshing training, training the trainers, mechanical supervision and mentoring in Ukraine. 24/7 "technical hotline open for end-users. Complete after-sales support in Ukraine	Comprehensive annual set – with each machine, followed by service support agreement with each operator[3]. Extra supplies — will be available at A3TECH by the end of 2023.	Fully established partnership with A3TEH-UKRAINE (in-country supply of spares, technical support, 2 rapid response teams, localization of production starts in 2024)[4] Demining Solutions Ltd., Kyiv – sole Agent (1st commercial operator of Ukraine in HMA).
FAE Group (Italy)*	**PT-300 D** Remote-controlled tracked carrier for clearing minefields (APM and ATM). works in the toughest conditions, including rough terrain, steep slopes up to 45°, swampy land, and in areas with dense vegetation.	2× PT-300 to be delivered to NPA	n/a	n/a	n/a	n/a	n/a	n/a

[2] Calculated from a moment of a ready-to-dispatch machine ex-works.

[3] Example: initially donated by the HGBF (USA) 4+4 MV-4/MV-10 will be further supported via FSD (Swiss Foundation for Mine Action) in close cooperation with DOK-ING.

[4] Example: On 18.10.23 SESU MV-4 no. 291 was hit by IED in Mykolaiv Region. On 20.10 it was evacuated to A3TEH-UKRAINE. On 31.10 it was fully repaired, tested and taken back by SESU.

Manufacturer/ machine type	Type of operations and Capacity (sq m per hour, clearance depth)	Stock in Ukraine already (in use by operators) / planned supplies	Price and maintenance costs	Production capacity availability for Ukraine	Logistics and delivery time	Service/ maintenance in Ukraine	Spare parts supply	Presence in Ukraine (representation office, local partner, joint ventures)
	Max working depth (mm) MODEL: 200/S – 200 300 mm 200/S – 225 300 mm 300/SC 1000 mm							
GCS AG (Switzerland)	GCS machines remote-controlled, mechanical mine clearance and area reduction operations. capacities: GCS-100 1,000 m^2 per hour at a depth of 150–200 mm; GCS-200 1,500 m^2 per hour at a depth of 250–300 mm	25 (by end 2023) Another 40 (2024)	Depends on customized needs	50 to 60 systems annually	3 to 6 months delivery time depending on the configuration and accessories required	Offers Technical Operator and Maintenance Training, Operational Management Training, Mentoring and Quality Assurance, fully operational Service and Maintenance workshop in Kyiv, two mobile service units presently in Ukraine. Planned to increase the mobile service units to four by the end of Q1 2024	Small warehouse in Kyiv where fast-moving spares are kept. Certain general spares are accessed locally in Ukraine while other more specialist spares are easily sourced from suppliers in Europe.	Permanent Representative Office in Kyiv est 2022 plus GCS Ukraine LLC a trusted local partner Nibulon
DIGGER (Switzerland)	**DIGGER D-250** medium-sized remote control demining machine intended to work in rural conditions (fields, forests, mountains). A versatile multi-function tool compatible with Caterpillar brand tools.	1x DIGGER D-250 1x DIGGER D-250 will be provided early 2024	total CHF 1'000'000[5]	7 machines per year	8 months, but will be reduced to 4 months since mid of 2024	One official partner in Ukraine for technical support and maintenance. Digger Foundation remote support. Digger Foundation Client Support Dpt. For specific local intervention	Full spare parts in stock in Switzerland are always available. Partial especially selected local spare parts in stock at partner plant. Specific brands officially represented in Ukraine (John-Deer, Bosh-Rexroth, Caterpillar) for warranty and specific spare parts	Partnership with Quadro International (maintenance, spare parts)

[5] The delivery of the two machines was funded by the Swiss Defence Ministry and Swiss Charity Foundation included each: one DIGGER D-250; one truck and trailer with a 20' ISO container; wearing and maintenance parts for 3 years; a mobile workshop fully equipped for field maintenance; initial training for 8 people (one week in location); two refresh training to be provided during the 3 first years of operation at users request; shipment and travel insurances

Manufacturer/ machine type	Type of operations and Capacity (sq m per hour, clearance depth)	Stock in Ukraine already (in use by operators) / planned supplies	Price and maintenance costs	Production capacity availability for Ukraine	Logistics and delivery time	Service/ maintenance in Ukraine	Spare parts supply	Presence in Ukraine (representation office, local partner, joint ventures)
	DIGGER Twin-Picks Tiller[6]: 250 ps 12 tons machine clearance rate of 300 to 1800 sqm/hour depending on the field conditions clearance depth – 25 cm. **SCRAPER** System to convert existing construction machines to permit remote control							
MEMATT (Turkey, produced by the state-owned company ASFAT)	**MEMATT** an unmanned mine clearing equipment with adjustable soil digging depth, durability, remote image transmission, unmanned control feature used in different soil types able to neutralize anti-personnel and anti-tank mines up to 8.5 kilograms and clear the existing vegetation on the field. Working Capacity: Humus Soil/Sparse Vegetation: 1900 m^2/hour Stony Soil/Medium Dense Vegetation: 1425m^2/hour Stony Land/Dense Plant: 950 m^2/hour	(1+1 planned for 2024)	n/a	n/a	n/a	n/a	n/a	n/a

**Manufacturers did not provide information upon GLOBSEC requests; information was taken from official sources.*

6 This machine is **CWA-15044** tested including survivability tests with antitank mines up to 8kg of TNT equivalent.

REFERENCES TO INFORMATION SOURCES

[1] https://www.kmu.gov.ua/news/na-zasidanni-sektoralnoi-robochoi-hrupy-z-protyminnoi-diialnosti-ukraina-predstavy-la-proekt-stratehii-a-takozh-plany-ta-potreby-na-2024-rik

[2] https://interfax.com.ua/news/blog/949637.html

[3] https://mspu.gov.ua/news/ukraina-naroshchuie-spromozhnosti-dlia-humanitarnoho-rozminuvannia-svoikh-terytorii

[4] https://rubryka.com/en/2023/08/02/rishennya-dlya-peremogy-persha-ukrayinska-mashyna-dlya-rozminuvannya-otrymala-sertyfikat-vidpovidnosti/

[5] https://www.me.gov.ua/News/Detail?lang=uk-UA&id=f8a49fe7-83e5-42b2-a811-9bd39c09e15e&title=UkrainskaMashinaDliaRozminuvannia

[6] https://rubryka.com/2023/10/11/norvegiya-vydilyt-finansovu-dopomogu-dlya-rozminuvannya-ukrayiny/

[7] https://www.regjeringen.no/en/aktuelt/nok-200-million-for-mine-clearance-activities-in-ukraine/id2999479/

[8] https://me.gov.ua/News/Detail?lang=uk-UA&id=f883788b-985d-4eb6-9f74-7b63dbdcf6f0&title=LokalizatsiiaVirobnitstva

[9] https://www.ukrinform.ua/rubric-economy/3745436-ulia-sviridenko-persij-vicepremerministr-ukraini.html

[10] https://mvs.gov.ua/uk/news/ukrayinski-riatuvalniki-otrimali-cergovu-partiiu-dopomogi-vid-estoniyi-ta-nimeccini

[11] https://kam.lt/lietuva-buria-ukrainos-isminavimo-koalicija/

[12] https://www.kmu.gov.ua/news/promova-premier-ministra-ukrainy-denysa-shmyhalia-na-zasidanni-uriadu-13-10-23

[13] https://forbes.ua/war-in-ukraine/yak-vlada-planue-vidnovlyuvati-deokupovani-teritorii-intervyu-zastupnika-golovi-ofisu-prezidenta-oleksiya-kulebi-04042023-12790

[14] https://www.bloomberg.com/news/articles/2023-10-10/nato-allies-to-form-mine-sweeping-force-to-clear-black-sea-route?srnd=politics-vp

[15] https://www.mil.gov.ua/news/2023/12/29/18-tisyach-kilometriv-deokupovanih-teritorij/

[16] https://www.youtube.com/watch?v=kybP6mo5Ckg

[17] https://www.mil.gov.ua/news/2023/12/24/islandiya-priednuetsya-do-it-koaliczii-ta-koaliczii-z-rozminuvannya/

[18] https://www.ukrinform.ua/rubric-economy/3804031-v-ukraini-z-pocatku-roku-rozminuvali-ponad-200-tisac-gektariv-silgospugid.html

[19] https://www.me.gov.ua/News/Detail?lang=uk-UA&id=88980f79-9457-4a65-af17-c10cc5d7a208&title=GumRozminuvannia

[20] https://www.ukrinform.ua/rubric-ato/3800690-minoboroni-v-2023-roci-oboronna-politika-ta-integracia-v-nato-vijsko-va-osvita-vijskovi-tehnologii-rozminuvanna.html

[21] https://www.me.gov.ua/News/Detail?lang=uk-UA&id=f2869f91-fb2f-4644-af0f-c4aa4eac7682&title=PidpisanoUgoduProNadanniaSloveniiuDopomogi

[22] https://www.me.gov.ua/News/Detail?lang=uk-UA&id=cbc70dfe-3921-4a22-bfdb-22a67049f08c&title=PidtrimkaInnovatsiiUGumRozminuvanni

[23] https://www.ukrinform.ua/rubric-society/3794873-litva-prezentuvala-ukraini-onovlenu-koncepciu-koalicii-z-rozminuvanna.html

[24] https://english.kyodonews.net/news/2023/11/1d20c631967f-japan-to-join-multinational-project-to-clear-mines-in-ukraine.html

[25] https://www.gichd.org/fileadmin/user_upload/GICHD_Difficult_Terrain_A5_10_WEB.pdf

[26] https://mepr.gov.ua/lisivnyky-prodovzhuyut-aktyvnu-tsyfrovizatsiyu-galuzi-ta-rozbudovu-infrastruktury-ministr-ruslan-strilets-z-robochym-vizytom-vidvidav-chernigivshhynu/

[27] https://www.mineactionreview.org/country/ukraine

[28] https://www.mineactionreview.org/assets/downloads/7721_Clearing_the_Mines_2023.pdf

[29] https://www.kmu.gov.ua/news/v-pytanniakh-rozminuvannia-ukrainy-uriad-pratsiuie-z-mizhnarodnymy-partnerami-iak-odna-komanda-ihor-bezkaravainyi

[30] https://interfax.com.ua/news/interview/946450.html

[31] https://lb.ua/society/2023/12/13/588809_deokupovanih_teritoriyah_vid.html

[32] https://www.mil.gov.ua/diyalnist/protiminna-diyalnist/

[33] https://armyinform.com.ua/2023/12/08/v-ukrayini-predstavyly-proyekt-strategiyi-protyminnoyi-diyalnosti-na-2024-rik/

[34] https://zakon.rada.gov.ua/laws/show/840-2023-%D1%80#Text

[35] https://dndivsovt.com/index.php/journal/article/view/353/324

[36] https://dndivsovt.com/index.php/journal/article/view/254/244

[37] https://reliefweb.int/report/ukraine/war-breadbasket-landmines-and-food-security-ukraine

[38] https://kse.ua/ua/about-the-school/news/kse-ta-ministerstvo-ekonomiki-proveli-v-kiyevi-demine-ukraine-forum/

[39] https://hromadske.ua/posts/boyepripasi-proti-rodyuchih-gruntiv-chomu-ukrayina-mozhe-vtratiti-status-goduvalnici-svitu

[40] https://en.ecoaction.org.ua/wp-content/uploads/2023/05/impact-on-soil-russian-war.pdf

[41] https://www.topleadprojects.com/environmental-project-main

[42] https://defence-ua.com/army_and_war/vms_ukrajini_otsinili_stroki_rozminuvannja_chornogo_ta_azovskogo_moriv_vse_ne_tak_j_pogano-14009.html

[43] https://odessa-life.od.ua/news/razminirovanie-akvatorii-chernogo-morja-stalo-izvestno-kogda-jeto-proizojdet

[44] https://armyinform.com.ua/2023/05/30/yak-gotuyut-ukrayinskyh-vijskovyh-vodolaziv-saperiv/

[45] https://www.kmu.gov.ua/news/minekonomiky-derzhavna-sluzhba-zainiatosti-rozpochala-vydavaty-vauchery-na-navchannia-za-profesiieiu-saper

[46] https://dsns.gov.ua/news/ostanni-novini/mi-udoskonaliujemo-mozlivosti-dlia-navcannia-nasix-vodolaziv-saperiv-sergii-kruk-rozpoviv-pro-pidrozdil-na-cerkashhini

[47] https://www.ukrinform.ua/rubric-ato/3728263-almaz-besi-ta-rita-ak-sobaca-komanda-dopomagae-saperam.html

[48] https://reinform.com.ua/32917/u-polshhi-rozpochalysya-kursy-z-peredachi-zsu-poshukovyh-sobak-dlya-rozminuvannya/

[49] https://radioera.com.ua/y-hmelnickomy-sobaki-saperi-z-ievropi-sklali-ispit-i-viryshat-na-rozminyvannia-deokypovanih-teritorii/

[50] https://mcgr.dsns.gov.ua/protiminna-diialnist-1/rejestr-vidanix-sertifikativ

[51] https://mil.in.ua/en/news/new-mine-action-center-opens-in-ukraine/

[52] https://me.gov.ua/News/Detail?lang=uk-UA&id=45ded95b-754a-4416-8bf7-3ac97a39c235&title=NagliadovaRada&fbclid=IwAR0ctSGs3CNEJRxdMr0_y%20Z3vpKmT4l0Y

[53] https://mvs.gov.ua/news/pirotexniki-dsns-vze-vikoristovuiut-otrimani-vid-uriadu-kanadi-robotizovani-kompleksi-dlia-rozminuvannia

[54] https://www.gichd.org/publications-resources/publications/guide-to-the-ageing-of-explosive-ordnance-in-the-environment/

[55] https://www.state.gov/panel-the-evolving-crisis-in-ukraine-how-different-parts-of-the-usg-are-reacting-in-real-time/

[56] https://www.bbc.com/news/world-europe-66133527

[57] https://www.popularmechanics.com/military/weapons/a45704486.north-korea-gave-russia-artillery-shells-to-use-in-ukraine/

[58] https://armyinform.com.ua/2023/07/19/uryad-zatverdyv-poryadok-vykorystannya-koshtiv-na-gumanitarne-rozminuvannya-u-mezhah-united24/

[59] https://www.gichd.org/fileadmin/uploads/gichd/Media/GICHD-resources/rec-documents/Mechanical_study_complete.pdf

[60] http://catalog.liha-pres.eu/index.php/liha-pres/catalog/download/76/862/1873-1?inline=1

[61] https://www.files.ethz.ch/isn/38542/2006_September.pdf

[62] https://www.gichd.org/fileadmin/uploads/gichd/Media/GICHD-resources/rec-documents/EO_Pollution_of_the_Environment_v17_web_01.pdf

[63] https://www.gichd.org/fileadmin/user_upload/GICHD_Difficult_Terrain_A5_10_WEB.pdf

[64] https://euromaidanpress.com/2024/01/04/russia-likely-plans-to-modify-x-32-missiles-with-cluster-munitions/

[65] https://agri-gator.com.ua/2024/01/05/iuliia-svyrydenko-rozpovila-pro-plany-z-pryshvydshennia-rozminuvannia-ahropolit/

[66] https://nv.ua/ukr/ukraine/events/2024-gumanitarne-rozminuvannya-plan-diy-ministerstva-ekonomiki-ta-agrariiv-50381366.html

[67] https://agropolit.com/news/27335-v-kabmini-rozpovili-yak-planuyut-rozvyazuvati-problemu-zaminuvannya-fermerskih-zemel

[68] https://kse.ua/wp-content/uploads/2023/05/RDNA2.pdf

[69] https://www.businessinsider.in/international/news/ukraine-is-firing-up-to-7000-rounds-a-day-a-fraction-of-the-60000-shells-russia-was-firing-earlier-this-year-report/articleshow/103764816.cms

[70] https://frontelligence.substack.com/p/counting-the-rounds-north-korean

[71] https://metinvest.media/ua/page/pdgotovka-3000-saperv-ta-95-mln-grn-nvesticy-vd-metnvestu

GLOBSEC
IDEAS SHAPING THE WORLD

Vajnorská 100/B
831 04 Bratislava
Slovak Republic

+421 2 3213 7800
info@globsec.org
www.globsec.org