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VPLIVI OBOROŽENIH SPOPADOV NA OKOLJE

THE EFFECTS OF ARMED CONFLICTS ON THE ENVIRONMENT

Povzetek Zaradi nenehnih ruskih vojaških operacij v Ukrajini je pregled vpliva dejavnosti vojaških sil na okolje zelo pomemben. Ta tematika ni pomembna le zato, ker je opustošenje neizmerno, temveč tudi zato, ker vsi podatki dokazujejo, da vojne vplivajo na pospešene podnebne spremembe. V tem prispevku ponujamo pregled nekaterih okoljskih vprašanj, ki so posledica ruske agresije, pogledamo pa tudi učinke prejšnjih tovrstnih vojaških spopadov. Obravnavamo onesnaževanje, ki ga povzroča vojna, ter povezavo med vojno in vodo ter se dotaknemo uničevanja določene infrastrukture (kulturne dobrine, energija, zdravje, promet) in njegovih posledic.

Ključne besede *Grajeno in naravno okolje, onesnaževanje, rusko-ukrajinska vojna, vojno opustošenje.*

Abstract With the ongoing Russian military operations against Ukraine, reviewing the impact of the military forces' activities on the environment is crucial. The topic is relevant not only because the devastation is immeasurable, but also because all the data proves that wars have effects that accelerate climate change. In this paper we review some of the environmental issues arising from Russian aggression, and we also refer to the effects of previous military conflicts of this kind. We deal with the pollution caused by war and the relationship between war and water. We touch on the destruction of some aspects of infrastructure (cultural goods, energy, health, transport) and its consequences.

Key words *Built and natural environment, pollution, Russia-Ukraine war, devastation of war.*

Introduction Wherever war conflicts occur, they cause severe damage to the built and natural environment almost every time. The intensity and impact vary from age to age, depending on the level of development of the military equipment and the military-political goal pursued.

We endeavour to point out, but not exhaustively, a peculiarity of armed conflicts; that destroying the enemy's military resources is a necessary but insufficient condition for victory. There are many other target groups whose destruction helps to break resistance, both directly and indirectly. Among these, we highlight environmental pollution, water-related issues, and the destruction of some aspects of infrastructure (cultural property, energy, health, and transport). Our research aims included the following:

- To point out that during war conflicts, the built and the natural environment are destroyed, often deliberately, in order to support the achievement of the military objective;
- To demonstrate, through examples of the Russo-Ukrainian war, that the provisions of international conventions do not or only rarely override military objectives in a war conflict;
- To show that, even with often contradictory battlefield reports, it is necessary and inevitable to point out through the power of publicity the need to preserve the built and natural environment.

1 METHODOLOGY

During our research, we considered the databases of international organizations – UN specialist agencies, international aid organizations, and international NGOs – as primary sources. The reason for this is that the data reporting of countries involved in any form of conflict is unreliable and often contradictory, and the information war can be demonstrated in many cases. We processed several domestic and foreign publications, trying to keep the balance. In conversations with experts, we tried to clarify conflicting information.

Our research is not without precedent. Several people in several places have dealt with the consequences of war. Different authors have already analysed NATO's new strategic concept (Szenes, 2022; Siposné Kecskeméthy, 2022) and written about the security effects of the Russia-Ukraine war (Resperger, 2022), or analysed the impact of the war on the economy (Halmai, 2022) and its consequences on security policy (Kis Benedek, 2022). Authors from Spain, Croatia, and Lithuania provided a summary of the environmental impact of the Russia-Ukraine war last year (Pereira et al., 2022). An extremely thorough and comprehensive analysis was carried out in a discussion of armed conflicts' effects on water resources (Schillinger et al., 2020).

The present study evaluated the indexed scientific publications of the last thirty years. At the time of writing, the Russia-Ukraine war has been going on for a year. We do

not have definitive data, but the consequences are already quantifiable in some areas. At the same time, it must be seen that war is also taking place in the information space, so we must treat the often-exaggerated claims on both sides with reservation. We have sought to use sources that are also verified, accepted, and referenced by international organizations. Of the conflicting claims, we preferred the more recent data. In presenting each of the effects examined, we chose to take an example or examples from a previous war conflict that showed that effect.

2 ENVIRONMENTAL POLLUTION CAUSED BY ARMED CONFLICTS

Even without any analysis, it can be seen that the devastation of war leaves nothing untouched around us, be it the built and natural environment or human existence and thinking. This is especially true from the First World War onwards, as increasingly modern and effective weapons have been used which are also more effective in destruction. These destructive devices pollute the environment in many areas, so their impact poses a threat in the longer term, even after the end of the conflict.

Studies on environmental pollution caused by armed conflict identify several potential sources of pollution. During the Gulf War, Kuwait's water resources were heavily polluted by the effects of the attacks on oil fields, which increased the concentration of metallic precipitation along the coast of the Persian Gulf. This threatened wildlife both on land and in the surrounding waters. During the Syrian civil war, the release of untreated wastewater, whether intentionally or accidentally, worsened water quality in the affected areas. Following the Sri Lankan civil war, the remnants of the weapons used in the war – explosive devices, unexploded projectiles and mines, abandoned military equipment – remained scattered, causing higher than usual concentrations of heavy metals, fluorine, and calcium in the groundwater. Other sources of pollution include hazardous waste from industrial and landfill sites and agricultural warehouses, pathological waste from hospitals damaged in the conflict, uncontrolled incineration of municipal waste, and the use of chemical weapons (Schillinger et al., 2020).

This type of pollution can also be encountered in the territory of Hungary. Tasar Airport became known during the Yugoslav Wars, where it played an essential role in managing the conflict. The technical condition of the fuel storage facilities and distributors that used to supply fuel to the military has deteriorated over the years, and the hydrocarbons stored in them have contaminated the soil and groundwater. Remediation is expected to be completed by the end of 2023 (MoD, 2023).

The life-threatening impact of unexploded explosive devices used in conflicts is a serious problem. According to Landmine Monitor data:

- In 2021, there were 5,544 mine accidents, where 3,355 people were injured and 2,182 died;

- Most accidents occurred in Syria, Afghanistan, Colombia, Iraq, Mali, Nigeria, Ukraine, and Yemen;
- More than 75% of the victims were civilians, and 50% were children;
- The number of cases is on an upward trend again after a record low number of 3,457 in 2013 (Landmine Monitor, 2022, p 3).

Of particular concern is the high child death rate, linked to curiosity and inadequate information. It is our personal experience that mine awareness in Bosnia and Herzegovina was still low four years after the end of the civil war. The mine awareness campaign launched by the Technical Chief of SFOR in 1999 dwindled away due to a lack of interest, as the number of mines collected between 1999 and 2002 was less than 11,000. Meanwhile, after the end of the civil war, the number of victims reached 1,296 (Padányi, 2002, p 89).

According to a report by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), since mid-November 2021 at least 15 mine accidents have been reported in the territory of Ukraine, in which 8 people were killed and another 16 injured (OCHA, 2022).

This is ostensibly a distant problem, but we must not forget that in the neighbouring countries (Croatia and Serbia), 9 mine accidents occur yearly. To further nuance the picture, in 2021, 77 years after World War II, the Hungarian 1st Explosive Ordnance Disposal and River Guard Regiment, responsible for disarming mines and unexploded projectiles, received nearly 2000 call-outs (Gajdos, 2022).

The air-polluting effects of armed conflict have been increasingly documented, but many contexts remain to be explored. The Iraq War of 2003 resulted in the emission of 250-600 million tons of carbon dioxide. As a comparison, it is worth stating that Poland emitted 282 million tons of carbon dioxide in 2015, while France emitted 290 million tons of carbon dioxide (Kriston, 2019). During the Gulf War, Iraqi troops set fire to 700 oil wells that burned for nine months. Under the influence of the burning wells, so much smoke was formed that it obscured the sun, causing a decrease in the average temperature, and about half a trillion tons of pollutants were released into the air (Gönczi, 2016, p 118).

In Ukraine, a result of the use of conventional weapons, fires that appeared among the fighting, explosions, the collapse of buildings, and the destruction of the earth's surface is the extended spread of dust particles and the appearance of toxic substances in the air. These effects directly cause many cardiovascular and respiratory diseases, exacerbated by the war's stress (Harari & Annesi-Maesano, 2022).

Until recently, air quality across Europe was steadily improving. However, the extraordinary conditions of the winter of 2022 are likely to reverse this trend. Due to the lack of gas supplies due to the Russia-Ukraine war, conventional fuels gained more ground in several countries. In Poland, solid fuel stoves were heated with

lignite, so there were cold days when the measured values for air pollution were four times higher than the hygienic limit in some places (Tiszóczy, 2022).

3 WATER POLLUTION AND ACCESS TO WATER IN ARMED CONFLICTS

Among the environmental impacts, the impact of conflicts on water is significant, and we do not need to emphasize the fact that the most crucial factor is drinking water. In order to ensure this vital element in a wartime environment, it is necessary to protect the infrastructure that provides it. On 27 April 2021, the UN Security Council unanimously adopted Resolution 2573 (2021), stressing the following:

- Ongoing military conflicts are seriously endangering the civilian population and civilian infrastructure, with the result that civilians have limited access to health care, water, sanitation, and energy, which are essential for maintaining their living conditions.
- The warring parties must respect the elements of critical infrastructure that support the living conditions of civilians.
- The UNSC condemns attacks on civilians and civilian objects during armed conflicts which fundamentally threaten the existence of the necessary conditions for survival.
- The UNSC demands that the warring parties fully comply with the obligations of international law, seizing every opportunity in the planning and conduct of military operations to protect civilians and civilian facilities, and refraining from attacking, rendering unusable, or removing systems necessary for survival (UNSC, 2021).

The decision was taken before the outbreak of the Russia-Ukraine war, which shows that on the one hand one of the worst practices of armed conflict is the attack on civilian targets, while on the other we see that this war is no exception in this regard.

The destruction or blockage of the infrastructure providing a water supply means that basic hygiene rules cannot be observed, increasing the risk of infectious diseases and making it challenging to create sanitary conditions for prevention and intervention. It is a common experience that children living in conflict-affected areas are 20 times more likely to die due to difficulties in accessing drinking water than in combat actions. Without a secure water supply, children are at risk of malnutrition and avoidable diseases such as diarrhoea, typhoid, cholera, and epidemic polio. According to UNICEF's April 2022 total, 1.4 million people in eastern Ukraine do not have access to safe water, and another 4.6 million people have limited access. More than 6 million people in the country struggle daily to get access to drinking water. During the first two weeks of the war, the infrastructure that provided the water supply suffered twenty cases of damage that affected its operation (UNICEF, 2022, p 6).

In towns and villages where intense fighting has been and is going on, not only is it physically challenging to get drinkable water, but the existing sinkholes have also been polluted. The water supply of the Donbas has become incidental, so residents are often forced to use unclean water sources (rivers, lakes). In numerous battlefield reports, we read that water utility facilities were physically damaged (water towers, water pipes, water lifting stations, sewage plants), making supply difficult (C&EO, 2022).

The use of water as a weapon is not new in this area. Russia annexed Crimea on 18 March 2014. The problem of water supply to Crimea, where natural freshwater sources are in short supply, arose immediately after the capture of the peninsula. The water supply of the peninsula, annexed from Ukraine, depends on an “external source”, the North Crimean Canal, which the Ukrainians blocked by a temporary dam on 26 April 2014. The channel can transport three hundred cubic metres of water per second. This quantity was intended to supply the peninsula’s inhabitants with drinking water, but it also ensured the daily irrigation of about a quarter of a million hectares of agricultural land (Istpravda, 2014). Russian troops reopened the channel on 26 February 2022, fulfilling one of their essential operational objectives (Reuters, 2022).

The number of water-related conflicts is constantly increasing. If we look at the numbers, we see that between 2000 and 2009, 219 water conflicts were recorded around the world, compared to 627 in the following decade (Armstrong, 2022).

A peculiar, but militarily sensible action is the use of water seals (swelling, flooding), which has been inherent in military operations for thousands of years. Skilled and experienced military leaders have always been aware that taking advantage of the terrain – including the opportunity provided by watercourses – can decide wars and help save soldiers’ lives.

As Sunzi wrote 2500 years ago, “Water can arrest the enemy, but it cannot be captured” (Tokaji, 2018a). Wu Qi has already gone further, articulating the use of water as a weapon: “If the enemy’s camp is set up in a low, wet place where the water cannot flow away, and persistent rain also falls, then the camp can be flooded out” (Tokaji, 2018b). An exciting and tragic continuation of this thinking is the military operation carried out in 1938 on the Yellow River by the Chinese Army. At that time, the continuous expansion of Japan had put the country’s leaders in an almost hopeless situation. In order to prevent, or at least slow down, further advance, the Yellow River dam was broken, flooding a vast area. The result is questionable: the Chinese troops gained time, but it cost the lives of hundreds of thousands of Chinese people who could not escape the flooding water (Lary, 2001).

One of the greatest captains of Central Europe in the 17th century, Miklós Zrínyi¹, himself used this tool masterfully during the defence of Međimurska against the Turks: he built a fish pond and connected rivers with canals (thus preventing a surprise attack) (Négyesi & Padányi, 2018).

During the Franco-Dutch Wars (1672-1679) when, under Louis XIV's leadership, the French occupied most of the Low Countries, the Dutch were only able to escape total military defeat by flooding large areas. In World War I, on 25 October 1914, King Albert of Belgium ordered the floodgates to be opened at Nieuwpoort to prevent a German breakthrough. The invading seawater gradually flooded the low-lying area between the Yser River and the embankment of the Diksmuide-Nieuwpoort railway line, which on 29 October forced the 4th German Army to retreat and shifted the centre of gravity of the attack. Austro-Hungarian troops used flooding at the foot of the Doberdo plateau: the locks and dams of the Dottori Canal, which connects the Isonzo River with the Adriatic Sea, were blown up the day after Italy's declaration of war. With the skilful transformation of the landmarks, a flood about 10 km long, 1-1.5 km wide, and 1-3 m deep occurred. At this stage, in the First Battle of Isonzo, the Italians made no attempt to attack (Kovács, 2014, p 101).

This tool was also used in the Russo-Ukrainian War. The Ukrainians, in order to slow the advance of the enemy, blew up the dam of the Irpin River, thus creating a flooded and swamped strip almost 30 km long. This made it impossible for the Russian attack to unfold from the north, facilitating the Ukrainian response and increasing their effectiveness (Figure 1, see page 100).

However, the impact of flooding on the built and natural environment cannot be assessed today (Simonov & Vasyliuk, 2022). What is known for sure is that some of the hazardous materials belonging to the apartment buildings, industrial plants, and warehouses in the flooded area have been washed into the river, and military equipment trapped in the area is also polluting the water. Once the water has drained away, this will continue to pollute the soil, posing a severe challenge to the people living there in the long term.

In Ukraine it is not unique to slow down the enemy's advance by changing the water level. The destruction of the dam built on the Oskil River in eastern Ukraine (2 April, 2022), so that the lowering of the water in the reservoir caused a rise in water levels, made it difficult for the Russians to change shores. From a military point of view, operational success is clear, but even here a realistic assessment of the longer-term environmental impacts remains to be seen. It is true that Ukrainian environmental specialists almost immediately set about planning post-war restoration variants, but a full and professional assessment of the consequences in the current situation is unrealistic.

¹ Miklós Zrínyi (1620-1664) was the ruler of Međimurska (Muraköz) and a Croatian-Hungarian lord who fought against the Ottoman expansion not only with the sword but also with the pen (as a warlord, author of military literature and a poet). He was responsible for the winter campaign of 1664, which brought him European fame because of the burning of the Ottoman military bridge in Osijek.

4 DESTRUCTION OF CULTURAL GOODS

The United Nations Educational, Scientific and Cultural Organization (UNESCO) stands out among the institutions promoting cultural heritage protection at an international level. The organization has established several international conventions to protect the world's cultural heritage, encouraging acceding states even without legally binding force. These international legal documents set out guidelines and strategies for action with a unified approach.

Article 1 of the International Convention for the Protection of Cultural Property in the event of armed conflict, signed at The Hague on 14 May, 1954, deals with the definition of cultural goods, which includes both movable and immovable objects that are of “great importance for the cultural heritage of people”, as well as buildings which preserve, display and, in the event of armed conflict, protect movable property (UNESCO, 1954).

At the same time, we know that rules are only worth as much as they are followed. The armed conflicts of the last 100 years have shown that the warring parties do not, or only very rarely, respect these rules. We also see that this kind of “compliance” does not depend on the level of development, cultural and religious background of the country in question. Some examples of devastation include:

- During World War II, 43% of Poland's monuments were destroyed. This figure reached 80% in Warsaw. According to some estimates, more than 500,000 works of art were lost from Polish collections in the Second World War, and 22 million books and about 40 kilometres of files are also considered lost from the national archives.
- The Royal Air Force also destroyed iconic buildings during the bombings of Dresden on 13 February 1945, such as the Opera House and the Frauenkirche, which served cultural and ecclesiastical purposes.
- Between 1933 and 1945, according to some estimates, more than 100 million books were destroyed in Germany for ideological reasons.
- In Mali, between 30 June and 11 July 2012, 14 mausoleums and tombs were destroyed or severely damaged by radical groups. In addition, the “sacred gate” of the Sidi Yahya mosque, dating back to the 15th Century, was destroyed, also for ideological reasons (Puskás, 2022, p 45).

This list includes the looting of the museum in Baghdad on 12 April 2003, and the robbery of exhibition sites in Mosul and Babylon. According to some reports, the artifacts left behind also attracted the interest of American soldiers (HRW, 2013). A unique addition to these stories is that some of the abducted objects have been rediscovered in European and North American museums.

On 26 August 1992, due to Serbian cannon fire, the National Library in Sarajevo caught fire and partially burned down. Hundreds of valuable manuscripts, books, and other irreplaceable documents were destroyed in flames.²

The Russia-Ukraine war is no exception to the destruction of cultural heritage. According to a UNESCO report of 9 January 2023, as a result of the Russian-Ukrainian conflict 234 sites, 104 religious buildings, 18 museums, 82 historically and artistically essential buildings, 19 monuments, and 11 libraries have been seriously damaged (UNESCO, 2023a).

The systematic destruction of cultural goods seems pointless, but an explanation exists. Milan Kundera's book demonstrates that the way to liquidate nations is to take away their memory and destroy their books, culture, and history (Kundera, 1999). It is no coincidence, therefore, that more than half of the sites on the UNESCO World Heritage List that are endangered for any reason are involved in armed conflicts (UNESCO, 2023b).

5 ATTACKS ON ENERGY INFRASTRUCTURE

An example of systematic attacks on energy infrastructure is the Operation Allied Force, i.e. the NATO air operations against the Federal Republic of Yugoslavia. Air operations began on 24 March 1999; in the second phase, by the decision of the NATO Ambassadorial Council, the list of targets was expanded, and the intensity of air strikes increased. The expanded list included fuel processing and fuel supply systems, energy centres, the main elements of the electrical supply network, and transport infrastructure. They destroyed 11 railway and 29 road bridges, including 7 Danube bridges (Bimbó, 2000).

A 2022 December UN report states that half of Ukraine's energy infrastructure has been destroyed due to targeted Russian attacks (Schlein, 2022). As a result, regular power outages cause difficult-to-manage problems in heating, water supply, education, information flow, transport, community life, and health services. Furthermore, during the winter millions of people were threatened by the cold without heating, and as a result, the risk of respiratory, infectious, and cardiovascular diseases increased. The situation is particularly complicated in eastern Ukraine, where more than 10 million people live.

As a result of the calamities in the Ukrainian energy sector, according to a report of 20 December 2022, the following situations have arisen (not an exhaustive list):

² *At this point, perhaps the reader – and, for reasons of personal involvement, one of the authors – feels a sense of absence in connection with the demolition of the Old Bridge in Mostar. One of the world's best-known bridges was also destroyed in the Balkan Civil War from targeted shots fired by a Croatian tank. It was not included in this list because the Hague court regarded the Old Bridge as a legitimate military objective and therefore did not hold the defendants accountable for its destruction.*

- The four operating nuclear power plants in Ukraine cover 55.5% of Ukrainian electricity production.³ The situation at the Zaporizhzhia nuclear power plant, which Russians and Ukrainians both accuse the other of attacking, is complicated. According to the latest reports of 7 January 2023, background radiation is average, but the power lines necessary to restart units 5 and 6 of the power plant have been damaged.
- 44% of the thermal power plants were occupied, and 86% were destroyed or badly damaged.
- 8% of mixed power plants (heat and electricity) were occupied, and 45% were destroyed or badly damaged.
- 5% of hydroelectric power plants have been occupied (Kahovka), and all the others are constantly under attack.
- 25% of renewable power plants (solar and wind) have been occupied and 6% have been badly damaged.
- The overhead lines in the power grid have been damaged in over a thousand places, and the operation of 8000 transformer stations has been permanently or temporarily interrupted.
- Gas extraction was suspended at more than 150 locations, and 350 gas and oil extraction units were destroyed.
- 60% of Ukraine's coal deposits are controlled by the Russians (International Energy Charter, 2022, p 12.)

The data described above is constantly changing as elements are being restored or as new damage is created to systems. What is certain is that it is the population that suffers the most from the consequences of targeted attacks on energy infrastructure.

6 DAMAGES TO HEALTH INFRASTRUCTURE

In the First and Second World Wars we could already see that international conventions are only worth as much as they have force to be obeyed. Such is the case when armed attacks occur despite the display of the Red Cross symbol, such as the sinking of the Russian hospital ship *Armeniya* (1941) or the German hospital ship *General von Steuben* (1945). It also includes terrorist bombings where air raids are carried out indiscriminately, along the lines of destruction, revenge and fear-mongering (Gernika-Lumo 1937, Dresden 1945, Chunking 1938-1941, Helsinki 1939, Coventry 1940, Tokyo, Hiroshima, Nagasaki 1945). Unfortunately, the trend continues today, so the Russia-Ukraine war is no exception.

According to the World Health Organization's representative in Ukraine, Jarno Habicht, Russia has recently attacked more than 700 medical facilities. In these attacks, 129 people were injured, and 100 were killed. The situation was further worsened by the fact that since the beginning of the war, nearly 800,000 houses have

³ *The fifth nuclear power plant is located in Chernobyl, which was permanently closed after the accident on 26 April 1986.*

become uninhabitable, so many people are living in communal accommodation. This further increases the risk of disease, thus complicating the functioning of an already congested and limited healthcare network.

According to the OCHA summary, as of 20 December 2022, 14.5 million people need medical assistance (OCHA, 2022).

We must also mention that millions of people fleeing war pose a serious health challenge in Ukraine and throughout Europe. The number of Ukrainians who fled to Europe reached 8 million in January 2023, with the number of internally displaced people approaching 6 million (HDX, 2023). The movement, care, and health support of such a mass of people is complex. In Hungary, as a country concerned, there is an accepted order to provide medical support to refugees. According to this, the government provides medicine, hospital care, and the benefits of the Hungarian people to those who remain here permanently, as required. So, they are entitled to primary health care, outpatient care, hospitalization, medication, medical aids, emergency dental treatment, prenatal care, obstetric care, and vaccinations (Government, 2022).

7 ATTACKS ON TRANSPORT INFRASTRUCTURE

Road transport infrastructure is always a priority target in war conflicts, as it almost always serves military purposes. Some well-known examples are the explosion of the Danube bridges in Budapest (1945), the destruction of the Old Bridge in Mostar (1993), and the bombing of seven Danube bridges in Yugoslavia (1999). In Ukraine, 431 bridges have been destroyed, and 25,100 km of roads were damaged, according to December 2022 data (Tóth, 2022).

The rail transport network has also had havoc wreaked on it during the war. In the first three months of the conflict alone, 27% of the railway track was damaged (6300 km), and 41 railway bridges were damaged (Geerts, 2022). The war also affects human resources, as 8000 railway workers serve in the Ukrainian Army, and 300 people among the casualties were railway workers (Railtarget, 2022).

The ports could not escape their fate either. Seaports under the blockade lost most of their former possibilities, so Ukrainian exports from these logistics centres have been significantly reduced. The monthly loss in Ukraine's metallurgical exports is estimated to reach \$420 million due to blocked seaports (UBN, 2023).

Conclusion The impact of war conflicts on the built and natural environment has lasting consequences and does not begin with the outbreak of war. Preparation, armaments, and the development of military power – even with state-of-the-art tools and methods – are also associated with significant environmental pollution. This is inevitable, as forces' training involves the release of harmful substances, the soil surface is disturbed, and the intense sound effects also leave their mark. Device development

is also energy-intensive, and the extraction and destruction of outdated devices are not environmentally friendly.

All elements of direct combat actions are polluting. Destruction, the ammunition used (incendiary weapons, uranium projectiles), the movement of military vehicles, the change in terrain, the impact of battlefield fires, smoke, dust, and noise pollution all impact people and the natural environment. In extreme cases, some areas become unusable for decades to come due to mines, unexploded projectiles, or chemical (and herbicide) weapons. An example of the latter is Agent Orange, used in the Vietnam War, which polluted the area for decades; but we now also know that the offspring of spray-exposed residents (and US soldiers) have three times the number of congenital disabilities than the average.

Even after the end of the conflict, the situation is not reassuring, as restoration is again an intense burden, and the elimination of traces of war and the professionalism of discharge are not always ensured. The restoration of the destroyed infrastructure entails costs that can only be achieved through international cooperation.

In our paper we have presented many, but not all, of the damages caused by war. The ongoing Russia-Ukraine war provides new evidence every day that the observance and enforcement of international conventions are always overridden by the political-military interests of the moment. Only two months after the outbreak of the war, the losses in Ukrainian infrastructure were huge (Figure 2, see page 100), and now already a whole year has passed.

Unfortunately, disrespect of international war regulations is not unique. We did not find any armed conflicts where all the written rules are respected. As long as this is the case, we must always reckon with the increased destruction of the built and natural environment, so studying the consequences, processing experience, and presenting the best examples of prevention and adaptation will remain an important task.

The reader may rightly ask, if this is an immutable process, what is the point of discussing it? We are convinced that silence is not the solution; sweeping the problem under the table does not help. Reaching out to the public via as many channels as possible is what could help, and we wanted to add to this, through our modest means.

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Figure 1:
The Irpin River Valley before and after the banking-up (based on Hildyard & Klemm, 2022, edited by the authors)



Figure 2:
Destroyed infrastructure and damage caused in Ukraine as of 26 April 2022 (based on KSE, 2022, edited by the authors)

	Infrastructure facilities	Number of items	Total damages, \$ mln
	Roads, km	23 574.00	29,480
	Residential buildings, thousands sq. meters	32 182.81	28,315
	Industrial enterprises, factories	173	9,792
	Civilian airports	11	6,817
	Railway stations and rolling stock	n/a	3,557
	Bridges and bridge crossings	289	1,622
	Healthcare institutions**	231	1,803
	Institutions of secondary and higher education	866	1,128
	Land fund, hectares	4224	873
	Ports and port infrastructure	2	622
	Military airfields	11	429
	Administration buildings**	75	410
	Kindergartens	535	416
	Religious buildings	95	325
	An-225 Mriya aircraft	1	300
	Shopping malls**	16	272
	Cultural facilities	130	226
	Storage infrastructure	138	225
	Other	-	1,343

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