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LITHUANIAN TERRITORIES CONTAMINATED WITH EXPLOSIVES: CASE STUDY OF KAUNAS

Rasa DOBRŽINSKIENĖ
Mykolas Romeris University
Maironio str. 27, LT 44211 Kaunas, Lithuania
E-mail rasa.dobrzinskiene@mruni.eu
ORCID ID: 0000-0001-6590-4164

Nikolaj DOBRŽINSKIJ
The General Jonas Žemaitis Miltitary Academy of Lithuania
Silo g. 5A, LT-10322 Vilnius
E-mail: nikolaj.dobrzinskij@lka.lt
ORCID ID: 0000-0003-3545-2501

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Abstract. *Public security is caused by various factors: from crime prevention to global security needs. Public security includes public relations regarding liquidation of dangerous consequences for human health and lives caused by criminal offences and natural disasters and elimination of reasons causing such consequences. According to A. Maslow, security is a primal need arising after struggle for survival; thus, other needs can be satisfied only after meeting the security need.*

The First and the Second World Wars as well as dislocation places of Russian military forces are the main reasons of Lithuanian territories contamination with explosives. Military conflicts and armed struggle are key factors in discussion regarding contaminated territories all over the world. Lithuanian territories contamination with explosives has been still a relevant problem because news is coming in of human encountering explosives remaining from war that was 70 year ago. These findings are threatening public security, health and life. Danger to security occurs due to the fact that explosives can be hit while digging ground and sometimes people do not recognize explosives or think that they are not dangerous. These thoughts can be denied by the numbers of dead or injured people, who treated war findings without precaution. Therefore, the ***aim*** *of this article – to discuss influence of contaminated territories with explosives on public security. In order to do this, the following* ***objectives*** *are identified: to discuss the concept of explosives and the risk to public; to describe the relevance of the problem in other countries in the world; to estimate the relevance of the problem of contamination with explosives in Kaunas city and Kaunas district.*

In order to discuss the danger of remaining explosives from war to public, concepts of explosive and explosions are described as well as danger of unexploded ordnances and their occurrences in Kaunas city and Kaunas district. These territories were chosen due to the fact that battles of the First and the Second World Wars took place more or less in these territories; in addition, separate German military troops and Russian military forces were dislocated there.

Keywords: *explosion, explosive, public security, Kaunas.*

Introduction

Public security is caused by various factors: from crime prevention to global security needs. Public security includes public relations regarding liquidation of dangerous consequences for human health and lives caused by criminal offences and natural disasters and elimination of reasons causing such consequences. According to A. Maslow, security is a primal need arising after struggle for survival; thus, other needs can be satisfied only after meeting the security need. However, despite the fact that it seems that public security is well supplied, unexpected cases occur, when single members of public are in danger due to circumstances than cannot be foreseen in advance. One of such cases – remaining explosives raising to earth surface or they are found while dogging ground. The problem of their recognition imposes

danger to human health and life, especially, when explosives are found by children, who treat them as not dangerous toys. In every case when explosive is found, all safety measures are taken in order to ensure public security and media informs periodically about the danger of these findings. Contamination with explosives of Lithuanian territories and territories in other countries is a relevant problem, which cannot be solved easily.

Thus, the **aim** of this article – to discuss influence of contaminated territories with explosives on public security. In order to achieve this, the following **objectives** were formulated:

1. To discuss the concept of explosives and the risk to public.
2. To describe the relevance of the problem in other countries in the world.
3. To estimate the relevance of the problem of contamination with explosives in Kaunas city and Kaunas district.

Methods applied: analysis and synthesis of scientific literature and legal acts were applied in this research.

Despite the relevance of the topic while discussing public security, this problem is not analyzed ins scientific literature, only single articles are prepared mostly related to researches of soil contamination with petroleum products; thus, Lithuanian and foreign legal acts and provisions regarding neutralization of founded explosives, inspection of contaminated territories and search for explosives has to be used in order to ground the research. On one hand, this is due to exclusive research area, on the other hand, not all aspects can be discussed openly in scientific world.

Concept of regular explosives and explosion

In order to analyze territory contamination with explosives, firstly, it is important to define the concepts of explosive and explosion. Lithuanian legislation defines explosives as “explosives and explosives which are considered to be explosives in the United Nations Recommendations on the Transport of Dangerous Goods, Class 1 of those Recommendations ST / SG / AC.10 / 1, as well as a device with an explosive substance (or from explosives), specially manufactured for explosion or for explosion under certain conditions” (Lietuvos Respublikos sprogmenų apyvartos kontrolės įstatymas, 2003). “Explosives means conventional ammunition with explosives other than mines, masked bombs and other munitions covered by this Convention, as amended in 1996. devices as defined in Protocol II to the United Nations Convention on the Law of the Sea of 3 May 1980, Protocol to the Convention on the Prohibition or Restriction of the Use of Certain Weapons Which May Be Excessively Injurious or to Have Indiscriminate Effects on Explosive Remnants of War. The description of the procedure for neutralizing explosive charges refers to an explosive as "a substance, device, device that can explode” (Sprogstamųjų užtaisų neutralizavimo tvarkos aprašas, 2008). Thus, to summarize the concept of explosive, it can be said that an explosive is a device with or from an explosive intended to explode or to explode.

The concept of explosion is similar in different sources. The Law on the Control of the Circulation of Explosives describes an explosion as a particularly rapid change in the physical state of a substance, during which a large amount of energy is suddenly released in a certain volume” (Lietuvos Respublikos sprogmenų apyvartos kontrolės įstatymas, 2003). Vilutiene and others define explosion a little more broadly, it is stated that "it is a process of extremely rapid chemical transformation of a substance, which is caused by the sudden formation of a large volume of heated gas and sudden heat release, which turns thermal energy into mechanical work” (Vilutienė, Dzidzevičius, & Žarys, 1999). Hence, an explosion is a change in the physical

state of a material that occurs very rapidly and results in the sudden release of large amounts of energy in a limited volume.

An explosion is common in many cases, including explosions due to the amount of gas accumulated upon a spark; flammable liquid containers exposed to fire; rifle ammunition thrown into the fire, and etc. An explosion may even bring benefits, such as in mining or construction, but in the cases mentioned above, it can cause significant damage. This article discusses only those threats that may be imposed by explosions of old explosive remnants of military base or liquidated military bases, in particular, due to the careless handling of detected munitions by the residents or simply unintentional damage during excavation and construction work.

The main constituent of explosives is an explosive, a chemical compound or mixture thereof which reacts chemically rapidly when exposed to relevant external conditions. During the reaction, high-temperature and high-pressure gases are released, which perform mechanical work as they expand. The uses of explosives are very wide: both in warfare and in civilian industries. In the civil industry, their main use is in mining, mining minerals in mines or quarries. Explosives are also often used to demolish old and disused buildings. And in warfare, explosives are used in the production of various explosives - ammunition, various projectiles, etc.

Danger of unexploded ordnance

As already mentioned, military ammunition remaining from wartime or liquidated military bases is still a threat today. The risk of unexploded ordnance can be assessed according to three criteria (Unexploded Ordnance (UXO), 1996):

1. Potential of contact with unexploded ordnance - this criterion considers the possibility of a person being exposed to unexploded ordnance, for example, by detecting an explosive during field work in agriculture.
2. Possibility of detonation of unexploded ordnance - this factor determines the probability of an unexploded ordnance exploding when a person encounters it, for example, due to ignorance, a person may try to carry an explosive and cause an explosion.
3. Consequences of an explosion of unexploded ordnance - This criterion covers a wide range of consequences of an explosion of unexploded ordnance. These can include injuries to humans, health risks related to the potential spread of chemicals in the area, chemical contamination of soil, surface water and groundwater.

Several factors affecting the probability of collision with unexploded ordnance are identified (Unexploded Ordnance (UXO), 1996):

• Number or density of unexploded ordnance in the area - the probability of encountering unexploded ordnance increases with the higher number of explosives found in a given area. Density also depends on the type of armament used;

• Depth of unexploded ordnance - a person is usually exposed to explosives on the ground or partially submerged in the ground, but explosives that are completely in the ground can only be encountered during excavation, agricultural or construction work in a potentially contaminated area. They can also be caused by geological activities;

• Size of unexploded ordnance - bigger unexploded ordnance is easier to spot, so most people tend to avoid bigger explosive when they notice it;

• Current and potential land use - the explosive is more likely to be found if the land is used for leisure purposes: hunting, camping, etc. If the area is used as pasture or the area is designated as a reserve, the probability of a person encountering unexploded ordnance is lower;

• Territorial accessibility - a person is more likely to encounter unexploded ordnance when the territory is freely accessible. Various populated areas, fields or sparse forests are more accessible to humans than wetlands or dense forests;

• Vegetation and cover of the territory - dense vegetation, wide root network can limit the rise of explosives to the surface and hide even a large number of unexploded ordnances;

• Soil type - the soil affects the depth of penetration of the explosive into the ground and the probability of activation. When hit on fine and soft soil or dirt, the explosive may not work and the explosive may not explode. Such areas with soft and fine soil increase the density of unexploded ordnance found. Also in soft ground, explosives may be deeper;

• Climate - the freezing line and the freeze-thaw cycle affect the depth of explosives and the amount they are released to the surface. The greater cold causes the greater depth of the freezing line and this affects the amount of explosives released. Meanwhile, more frequent freeze-thaw cycles result in explosives being brought to the surface faster.

Any explosive detected poses a greater or lesser threat. To reduce the risk, an evacuation of a specific area may be performed when an unexploded standard explosive is detected. The size of the evacuation radius depends on the net explosive weight (NEW) of the explosive, which is usually determined by taking 50 % of the total weight of the explosive.

Contamination with military ammunition in world countries

World wars and various other military conflicts have been intense, both in Europe and on other continents, contaminating territories with explosives and other ammunition. The causes of this pollution can be not only battles, but also minefields being prepared for defense or even hastily destroyed ammunition depots to prevent enemies from taking advantage of them. According to the annual data provided by the Monitoring and research committee on mine contamination, in 2016 as many as 61 states have minefields and mine-contaminated (International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC), 2017) areas (see Table 1).

Table 1. Mine contamination of the territories of the world
(International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC), 2017)

Contamination	**Country**
Very high (more than 100 km^2)	*Angola, Chad, Afghanistan, Cambodia, Thailand, Azerbaijan, Croatia, Turkey, Iraq, Bosnia and Herzegovina*
High (20–99 km^2)	*Ethiopia, Eritrea, South Sudan, Zimbabwe, Colombia, Sri Lanka, Lebanon*
Medium (5–19 km^2)	*Sudan, Argentina / United Kingdom, Chile, Tajikistan, Jordan, Palestine*
Low (less than 5 km^2)	*Mauritania, Mozambique, Nigeria, Ecuador, Peru, Armenia, Kosovo, Serbia, Democratic Republic of the Congo, Somaliland*
Not indicated	*Nigeria, Senegal, Somalia, Cuba, China, India, North Korea, South Korea, Laos, Myanmar, Pakistan, Vietnam, Cyprus, Georgia, Russia, Ukraine, Uzbekistan, Egypt, Iran, Israel, Libya, Morocco, Oman, Syria, Yemen, Western Sahara, Kyrgyzstan*

The total area of land cleared during mine clearance in 2016 was 170 km^2, which is not large compared to the existing scale of contaminated sites.

More attention is also being paid worldwide to the destruction of cluster munitions, which, according to the Monitoring and Research Committee, 26 countries are contaminated (International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC, 2018) (see Table 2).

Table 2. Contamination of the territories of the world with cluster munitions
(International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC), 2017)

Contamination	**Country**
Very high (more than 1000 km^2)	*Vietnam, Laos*
High (100–1000 km^2)	*Cambodia, Iraq*
Average (5–99 km^2)	*Afghanistan, Bosnia and Herzegovina, Chile, Germany, Lebanon, South Sudan, Syria, Ukraine, Yemen, Kosovo*
Low (less than 5 km^2)	*Croatia, Montenegro, Serbia, Western Sahara*
Not indicated	*Angola, Azerbaijan, Chad, Democratic Republic of the Congo, Iran, Libya, Somalia, Sudan, Tajikistan, Argentina/United Kingdom*

In 2017, an area of about 93 km^2 was cleared of cluster munitions worldwide and about 153,000 munitions were destroyed (International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC, 2017). Thus, the annual clean-up of explosives in various parts of the world still does not solve the widespread problem of explosives contamination after the world wars and other military conflicts. Many areas of the world contaminated with explosives are covered with mines and cluster munitions. Lithuania is distinguished by the fact that standard explosives are found here, the use of which does not cover large areas.

Contamination by explosives in Kaunas city and Kaunas district

The United Nations Convention uses two different concepts to address certain conventional weapons, which are *unexploded explosives* and *abandoned explosives*. These concepts clearly distinguish two main causes of contamination. The first concept means that one of the contaminations by explosives causes is related to the ordnance, which has been prepared during conflicts or battles, but, for some reason, was not activated or did not explode. The latter concept refers to the second possible contamination cause, i.e. the explosives have been stored and protected, but, for some reason, were not utilized and left for disposal.

When examining the reasons of explosives that are being detected because of the battles that took place in the territory of Lithuania, it's important to take the First and the Second World Wards into account since various standard explosives have been utilized during these events. With the outbreak of the First World War in 1914, Lithuania fell into the war zone from the first day. In the August 1915, persistent battles for Kaunas city took place, while in September 1915, Germany occupied almost the entire territory of Lithuania and deployed separate groups of German troops, the last of which were withdrawn only in 1919 (Visuotinė lietuvių enciklopedija 2010).

During the Second World War Lithuania found itself between two fronts and various large-scale battles took place, during which a wide range of explosives have been utilized, including artillery, mortars, and aviation bombs. During the German invasion to the East and the attack of the Soviets at the end of the Second World War, many tank battles and artillery cannon fires took place in the territory of Lithuania. In 21st of June, 1941, German bomber raids against Soviet troops dislocated in different Lithuania's cities have begun. Bomber raid flights

have been executed over Kėdainiai, Šiauliai, Kalvarija, Jurbarkas, Kaunas, Alytus, Panevėžys, and Kaunas cities. 231 bombers have participated in the operation, attacking important targets, including two artillery deposits (*Lietuva 1940–1990: okupuotos Lietuvos istorija* (2007). After their destruction, artillery shells could be scattered over a larger area of the land.

As already mentioned, the reason of explosive contamination in these territories is no only the explosives used in the battles, but also the ammunitions left, disposed of, or stored in the war zone. After the Second World War, Russian military forces were deployed on Lithuanian territory. These forces occupied approximately 1.2% of the territory of Lithuania, i.e. 68 thousand ha. The territories included various military bases, warehouses, military training grounds dispersed throughout Lithuania, while the airborne division was located in Kaunas. In addition, large fuel, clothing, and ammunition warehouses were deployed in Kaunas. Military units were also established in Kaunas and Kaunas district (Surgailis, 2005). These facts approve that the explosive contamination in the territories of Kaunas and Kaunas district is quite possible up to day. Despite the fact that almost seven decades passed after the war, its legacy still poses a risk, especially when explosives, such as bombs, projectiles, mines, and grenades are found.

Information gathered in recent years proves the fact that the contamination by explosives in Kaunas and Kaunas district is still a big issue, as various explosives are systematically found in different parts of the city. The last known incident took place in Aleksotas when children found dangerous military ammunition. There are loads of explosive devices in the area of Kaunas city. During the last year alone, soldiers of Juozas Vitkus Engineering Battalion removed around 80 units of aviation bombs weighing from 50 to 250 kg. Some of these explosives were possibly filled with explosive material, incendiary model, and with chemical cartridges. This year on the slope of Aleksotas near J. Bakanauskas Street and in the stream flowing below it, the remnants of the aviation explosives were washed away after heavy rains. Such explosive contamination is common since dropped aviation bombs frequently did not explode. Unexploded ordnance projectiles are also frequently found in Kaunas city. By the way, dangerous explosives were found in Aleksotas in 2020. After the heavy rain washed down the slope in J. Bakanauskas street, the aviation bomb has been found and the plan “Skydas” has been introduced in the place of the incident. The miners found the explosive to be dangerous and detected more explosives near the place (https://www.delfi.lt/news/daily/crime/kaune-pradedami-isvezti-gatveje-rasti-sprogmenys-kada-ji-bus-atidaryta-neaisku.d?id=84725673). Suchlike situations emerge in the news several times a year. Incidents like this indicate the fact that explosive wartime leftovers can rise to the surface without human influence, simply because of natural phenomena, such as the washing of the soil surface by the rain or the activation of stream water resulting in stronger water jet. Since the Independence of Lithuania, over ten citizens have been killed and about twenty injured because of the explosives and these numbers prove the fact that explosive contamination is a real threat to public security. The accidents happen because people finding the explosives try to dismantle or burn them.

The mentioned cases prove that post-war findings are still present in Kaunas and pose risk to the society. The risk can arise at any time, both because of natural phenomenon, accidental discovery, excavation works, and similar. The corresponding numbers of the accidents prove the risk. Kaunas has 10.8 explosives per km^2 and occupies only the fourth place among large cities in terms of the number of explosives found per 1 km^2. However, although these numbers are decreasing every year, the threat to public security remains, as there are areas where explosives contamination is highly concentrated. The contamination of the Kaunas district territories is lower than in the city. According to the numbers of the explosives found, there are 74.8 explosives per 100 km^2 in the district. One of the most contaminated territories

of Kaunas district is Pilainiai Engineering Regiment, which occupies 91.3 ha. The area is full of remaining explosives and can be characterized as heavily polluted by oil.

Conclusions

In summary, it can be said that, despite the fact that military conflicts are long over, the consequences of these events are still being felt in Lithuania. Of course, Lithuania is not the only country that faces this problem. The same threats are observed around the world. The remaining unexploded ordnances pose a threat to public security. Not all people, especially children, are able to identify them as dangerous objects, and some of them are curious or naive that post-war finds of such age cannot pose a threat. However, the presented concept of explosives, the dangers posed by unexploded ordnance and the explosives still found these days indicate a threat to public security. Such territories exist throughout Lithuania, and Kaunas and Kaunas district, due to one or other actions of the First and Second World Wars, are moderately contaminated with explosives in these areas, where explosives remain from wartime are systematically found in certain places.

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