Combating environmental crime: illegal cross-border waste transport and utilising modern technologies

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Abstract

This contribution provides a comprehensive introduction to the issue of environmental crime and illegal cross-border waste trafficking, with a focus on the EU legislation to combat these phenomena. The article begins by presenting a wide range of challenges associated with environmental crime and its impact on the environment and public health. It includes a definition of the scientific methods used in the creation of this contribution.

The article describes the EU tools available, such as the Serious and Organised Crime Threat Assessment (SOCTA), European multidisciplinary platform against criminal threats (Empact) and Secure Information Exchange Network Application (SIENA), which are key instruments used to monitor and suppress criminal threats in the realm of organised crime, of which environmental crime is a part. The article analyses their utilisation and effectiveness in identifying, monitoring and penalising actors engaged in environmental crime and their illegal activities within the EU.

Another section is dedicated to illegal cross-border waste trafficking, encompassing the global scope of waste production, definitions of key terms, and statistical data collected by Eurostat, which illustrate the extent and severity of this problem. In the section focused on combating this issue, the contribution examines the use of modern technologies, particularly unmanned vehicles and methods such as lidar and photogrammetry, as effective tools for detecting and investigating illegal activities related to cross-border waste transport, providing specific examples of their use. There is a focus on the experiences of the Slovak police using these tools in real-world conditions and their contribution to combating illegal waste transport.

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In the concluding section of the contribution, current challenges and future prospects in the fight against illegal waste transport are identified, with an emphasis on the need for further action, cooperation and innovation in this field.

Keywords: environmental crime, transboundary shipment of waste, drones.

Environmental crime and illegal cross-border waste transport

Introduction to the issue of environmental crime and illegal cross-border waste transport

Environmental crime currently represents one of the world's fastest-growing security problems. Given the increasing occurrence and severe consequences of these crimes, greater attention needs to be given to the relevant regulations and sanctions. Within the EU, this issue is systematically addressed through Directive 2008/99/EC on the protection of the environment through criminal law, as amended ([2]). This directive responds to the rise in environmental crimes with international implications. The preamble of Articles 2 and 3 of this directive clearly expresses the EU's concern about the growing number of crimes that transcend national borders. These acts, posing serious threats to the environment, require not only an adequate response but also effective legislation. Over the past decade, it has become evident that existing punitive provisions are often insufficient to achieve the desired compliance with environmental protection laws. The low number of successfully investigated environmental crimes underscored the need for a comprehensive review of Directive 2008/99/EC. The reasons for the revision are apparent – new information and scientific evidence on the harmful environmental and economic impacts of these crimes compel us to re-evaluate the issue. The dynamics of this process clearly indicate the need for the revision and improvement of legislation in this area. New legislation should address not only existing shortcomings but also current challenges in tackling environmental crime. We witness how the negative effects of these crimes extend beyond the environment, impacting the economy, social stability and public health (Kern, 2023a). The above statements are directly addressed by Directive (EU) 2024/1203 on environmental protection through criminal law, replacing Directives 2008/99/EC and 2009/123/EC ([3]). In this directive, the European Parliament and the Council of the European Union unequivocally express the view that the sanction rules under Directive 2008/99/EC of the European Parliament and of the Council and under Union sectoral law in the field of environmental protection are not sufficient to ensure compliance with Union law on environmental protection. Such compliance could and should be increased by the availability of effective, proportionate and deterrent criminal sanctions that correspond to the seriousness of the offences and can express greater societal disapproval than the use of administrative sanctions alone. The complementarity of criminal and administrative law is of fundamental importance for the prevention and deterrence of unlawful actions that harm the environment.

With the increasing trend of environmental crime, financial motivation for its commission is particularly associated, serving as the key driving force behind this form of illegal activity. The waste trade sector in particular has reaped illegal profits amounting to tens and even hundreds of millions of euro in recent years. These revenues not only fund other forms of criminality but also serve as sources of corruption that undermine societal integrity. Throughout the world, waste trafficking is increasingly recognised as a serious criminal offence with close ties to corruption, organised crime and money laundering (Isarin et al., 2023).

In addition to the economic consequences, environmental crime is linked to irreversible damage. The creation of illegal waste dump sites and other crimes related to unauthorised waste disposal can lead, among other things, to

the endangerment of biodiversity and the extinction of certain plant and animal species. This results in biological imbalance, disrupting ecosystems and causing serious consequences for the entire environment.

Detection and investigation of environmental crime is a key aspect of law enforcement efforts to combat the consequences of this criminal activity successfully. The first step in addressing this problem is identifying the perpetrators and determining the extent of their actions. A thorough investigation is essential for the fair punishment of offenders and the removal of the harmful consequences of their actions. Detecting and investigating environmental crime not only serves to repress and punish offenders but also plays a key role in restoring damaged ecosystems and preventing further offenses, especially when potential perpetrators are aware of the high likelihood of detection and severe penalties. This creates an environment that deters potential offenders. The fight against environmental crime is, therefore, crucial for preserving a healthy environment for future generations. Success in this area is inextricably linked to the effective detection and investigation of crimes, supported by relevant legal tools, including European legislation.

Methodology

This contribution is based on the analysis of the issue from the perspective of international legislation and available EU tools. The foundation of the contribution is a multidisciplinary approach. The common methodology comprises five main research steps: initial theoretical research of international legislation, analysis of available EU tools in combating organised crime, analysis of available statistical data, the current state of using unmanned vehicles in forensic activities from a global perspective, and the incorporation of authors' own experiences of investigating environmental criminal activity.

EU tools to combat criminal threats in the field of environmental crime

In an effort to strengthen security and enhance cooperation in the fight against criminality, the EU operates the SOCTA and Empact systems. These tools play a crucial role in identifying, assessing and monitoring threats associated with criminality in the EU.

SOCTA is a comprehensive report prepared by the European Union Agency for Law Enforcement Cooperation (Europol) that analyses organised crime in the EU over a specific period. It focuses on identifying major trends, patterns and new threats, providing Member States and LEAs with strategic information essential for effectively combating organised crime, shaping legislation and fostering joint activities (Europol, 2017).

Empact coordinates and integrates the actions of EU Member States in priority areas. It identifies key areas of criminality that require special efforts and collaboration. Environmental crime was one of the 10 priorities of this platform within the EU's 2018–2021 political cycle and remains a priority in the 2022–2025 cycle, and specific measures have been created to combat particular illegal practices threatening the environment (Europol, 2022a).

That environmental crime is a priority of Empact emphasises the importance of environmental protection and sustainable development. The main goal is to suppress illegal activities such as illegal waste transport, illegal trade in endangered species, illegal logging and other forms of environmental pollution. Making this a priority seeks to prevent not only ecological damage but also potential consequences for public health (Europol, 2022a).

Within Empact, joint operations and operational teams focused on environmental crime are created and implemented, bringing together experts in law, science and technology from Member States. Their role is not only to identify and expose perpetrators but also to improve preventive measures and operational police cooperation in the fight against environmental crime.

Illegal cross-border transport of waste

The development of industrial activities and increased consumption since the 1970s has led to an exponential increase in waste production worldwide: in 2022, the size of the waste management market was estimated at USD 1 052.58 billion, and it is expected to reach approximately USD 1 985.06 billion by 2032 (Precedence Research, 2024). Looking at the statistical data over time, it can clearly be stated that the waste trading market is a multibillion-dollar industry that requires special attention from law enforcement authorities. Demand is not only stable but also sharply increasing. Challenges related to waste management in rapidly growing urban areas affect not only low-income countries but also cities in developed economies. However, the rapidly growing volume of waste has exceeded the capacities of states for legal and economically viable waste management. This phenomenon has prompted a push for ecological solutions and environmentally friendly practices, simultaneously driving entrepreneurs to dispose of waste, often through illegal transport outside the country of origin. In an attempt to reverse this trend, international, European and national legal regulations have been enacted to govern the management of waste, especially hazardous waste.

The Basel Convention plays a crucial role in the international regulation of cross-border movement of hazardous waste and its disposal. It categorises hazardous waste and establishes rules for its export, import and transport. The convention emphasises the obligation of contracting parties to prohibit the import of hazardous waste for disposal purposes. Legitimate import, export and transport of hazardous waste are permitted only with the consent of all contracting countries, and each country has the right to ban the import of hazardous waste into its territory completely. With the establishment of the Schengen area after 2007, the number of cross-border waste shipments within the EU increased, including those involving non-EU countries. This trend further intensified after China, the leading country in plastic recycling, restricted the import of plastic waste (Kern, 2023b).

EU Member States are bound by the obligation, under the Basel Convention, to dispose of or recycle their waste primarily within their own territories. The ban on the export of plastic waste to China, known as the China ban, significantly affected cross-border waste shipments. EU legislation regulates waste categorisation, disposal and recycling processes, and defines the responsibilities of waste producers, taking into account transport conditions within the Schengen area and relationships with non-EU countries.

Illegal cross-border transport of waste poses a serious threat to the environment, human health and the economy, and is often driven by the pursuit of illegal profits, with perpetrators ignoring existing environmental standards and regulations. Waste is illicitly transported from its origin to other areas, often to countries outside the EU, where it is processed more affordably or without adherence to relevant environmental legislation. This creates a global problem, as illegal waste transport transcends borders and causes harm not only in the country of origin but also in the countries to which the waste is sent.

The aforementioned Basel Convention provides a comprehensive legal tool for regulating cross-border waste transport to minimise its environmental impact and protect public health. Since illegal waste transport occurs across borders, the Basel Convention offers an essential framework for international cooperation in this field. Signatories to the Basel Convention have committed to treating any illegal cross-border transport of waste as a violation of the law and a criminal offence (Secretariat of the Basel Convention, n.d.).

The EU pays special attention to waste transport regulation and the prevention of illegal waste transport. Regulation (EC) No 1013/2006 of the European Parliament and of the Council on shipments of waste, as amended (hereinafter 'the regulation') ([52]), constitutes a fundamental and binding framework for waste transport regulation in the EU. It defines terms such as waste, specifies the relevant authorities and people involved in cross-border waste shipments, and, notably, in Article 2, paragraph 35 defines illegal cross-border waste transport itself as any shipment of waste affected:

(a) without notification to all competent authorities concerned pursuant to this Regulation;

(b) without the consent of the competent authorities concerned pursuant to this Regulation;

(c) with consent obtained from the competent authorities concerned through falsification, misrepresentation or fraud;

(d) in a way which is not specified materially in the notification or movement documents;

(e) in a way that results in recovery or disposal in contravention of Community or international rules;

(f) contrary to Articles 34, 36, 39, 40, 41 and 43;

(g) which, in relation to shipments of waste as referred to in Article 3(2) and (4), has resulted from:

(i) the waste being discovered not to be listed in Annexes III, IIIA or IIIB;

(ii) non-compliance with Article 3(4);

(iii) the shipment being affected in a way that is not specified materially in the document set out in Annex VII.

At the same time, this regulation introduces the categorisation of waste according to its hazardousness and economic usability into three main categories: 'green-listed' waste, 'amber-listed' waste and other waste.

Green-listed waste includes environmentally acceptable and recyclable waste with a high level of recyclability. Examples include waste suitable for producing new products or extracting economically valuable substances that are not inherently hazardous. The regulation allows the transport of such waste across internal and external borders for recycling purposes. Shipments of green-listed waste must be accompanied by information in accordance with Annex VII of the regulation, requiring details about the transport organiser, waste producer, transport company and facilities authorised to receive and utilise the waste. Information about the type and quantity of transported waste is also required. Transport of green-listed waste is permitted only if the waste is correctly sorted from other components, catalogued according to the waste catalogue, not excessively contaminated, and transported directly

([52]) Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (OJ L 190, 12.7.2006, p. 1).

from the producer to the recycling facility. In this context, a contract is also concluded between the exporter and the importer of green-listed waste, in which the exporter commits to supplying a certain type and quality of waste, and the importer demonstrates the ability to receive and utilise such waste. Conversely, amber-listed waste includes waste that is hazardous according to the Basel Convention or is contaminated, and its recycling mainly involves energy utilisation, cement production or obtaining economically relevant components or substances with high technological and safety standards. Due to the higher level of hazard and processing complexity of this waste, its transport is strictly regulated within the EU and the non-EU countries concerned. Regulation of its transport primarily involves prior written notification and consent from all countries involved. The consent of the destination country is contingent on, among other things, receiving mandatory data that specify precisely the quantity and type of waste, as well as the relevant waste processing method, which must meet the conditions of the country allowing the recycling of that specific waste. Such consent is time-limited and allows the import of waste into a specific facility in the destination country. The regulation also defines conditions for providing guarantees to cover costs in cases where an authorised shipment fails to meet the conditions set out in the regulation. In the event that a person responsible for illegal waste transport is identified, it is possible to impose an obligation on them to take back the waste at their own expense or at the expense of another obligated entity, such as the exporting state. Affected states are not entitled to oppose or object the return of the waste or the process of its disposal or utilisation at the location where the illegal waste transport is detected (Regulation (EC) No 1013/2006).

When assessing the legality of actions by individuals or legal entities regarding cross-border waste transport, it is necessary to consider other international legal regulations governing specific waste streams. In addition, other directives and acts must be taken into account. Examples include Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directive 2000/53/EC on end-of-life vehicles, Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and Directive 2012/19/EU on waste electrical and electronic equipment; Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment; and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

For a better understanding of the issue of waste export, especially its quantity, it is necessary to look at the available statistical data for the year 2021 on waste transport between Member States and non-EU countries. The data are publicly available on the Eurostat website. In 2021, Member States exported almost 15.0 million tonnes of non-hazardous waste, while 8.8 million tonnes of hazardous waste were exported from one Member State to another. From 2010 to 2021, the amount of hazardous waste exported from Member States significantly increased from 6.1 to 9.6 million tonnes. From 2016 to 2017, there was a sharp increase in exports, which increased by more than one fifth, from 6.1 to 7.4 million tonnes (+ 22 %). In 2021, the Member States with the highest amount of exported hazardous waste were France (2.8 million tonnes), Italy (1.3 million tonnes), Germany and the Netherlands (both 1.1 million tonnes). The export of hazardous waste from Member States to countries of the European Free Trade Association, especially Switzerland and Norway, decreased from 568,000 tonnes in 2019 to 450,000 tonnes in 2021. Hazardous waste exports to OECD countries outside the EU and countries of the European Free Trade Association amounted to 399 000 tonnes in 2021. This accounted for 4 % of the total amount exported. The main destinations among these countries were the United Kingdom and Türkiye. The amount of hazardous waste exported from Member States for disposal in the destination country was 1.7 million tonnes in 2021. Over the same period, 2010–2021, the amount exported for recovery increased from 4.3 million to 7.9 million tonnes (Eurostat, 2024).

Combating illegal cross-border waste transport and utilising modern technologies

The production of waste that can no longer be reused exceeds the capacity for storage/disposal, especially in advanced economies. Organised criminal groups, therefore, seek economically advantageous solutions to dispose of such waste in countries where the costs of disposal are significantly lower and where action to combat such illegal activities is negligible. These factors contribute to the increasing number of illegal waste shipments within and outside the EU. Combating illegal cross-border waste transport effectively, therefore, requires a global perspective and close cooperation between Member States. International collaboration is a key tool in detecting and investigating criminal activities related to illegal cross-border waste transport. Mechanisms for exchanging information between countries utilised thus far enable the rapid identification of illicit activities and the efficient coordination of actions taken. The EU has established platforms and systems that allow Member States to share information about illegal waste transport. In this context, Europol plays a crucial role, especially in coordinating the fight against environmental crime, including illegal cross-border waste transport. Europol has developed an information exchange system called SIENA. SIENA enables relevant authorities from Member States to quickly and securely share real-time information about crimes. In the case of illegal cross-border waste transport, Europol can coordinate joint operations through this system, provide analytical and technical support, facilitate cooperation and information exchange between individual Member States, and support the formation of operational groups and joint investigative teams (Europol, 2022b).

Rapid technological progress provides new tools for detecting and investigating environmental crime, including illegal cross-border waste shipments. Satellite technologies, geographic information systems and software applications enable detailed tracking of waste movement and the identification of potential illegal activities. These tools provide investigators with valuable data and analytical means to establish patterns and suspicious routes of waste movement.

One such tool is unmanned aerial vehicles (UAVs), commonly known as drones. These are any autonomous or remotely controlled vehicle operated via pre-programmed computer software or a ground-based remote pilot (D'Andrea, 2014). Drones are often associated with the ability to perform '3D' (dirty, dull and dangerous) missions, leading to their widespread use and in-depth exploration in various fields. Drones enable procedures to be carried out quickly and efficiently and with fewer risks than manned operations (Naidoo et al., 2011), such as delivering essential supplies to individuals affected by disasters in situations where traditional routes are inaccessible. Although drones have been widely adopted in many forensic procedures, the evidence regarding the categorisation of drone applications in forensic science is still limited and unclear, highlighting the need for further research in this area (Mohd Sabri et al., 2023).

Despite continuous advancements in this field, drones have become invaluable aids in crime scene detection and documentation. Their use allows for rapid and efficient monitoring of the extent of illegal cross-border waste transport and provides investigators with detailed visual information about crime scenes. Of course, drones primarily serve as a means of flight, carrying other technology or detectors. One such technology is lidar, which is a specialised type of sensor that uses laser beams to measure distances and create accurate 3D surface models. When used with drones, lidar allows precise mapping of terrain, including illegal waste dump sites. This technology can identify dump sites hidden under vegetation or in hard-to-reach areas, significantly simplifying the localisation and documentation of criminal activities (Rango et al., 2006). Photogrammetry, which combines

photographs obtained using drones, also plays a crucial role in documenting crime scenes. This method enables the creation of high-quality 3D models of terrain and objects, including locations with illegally deposited waste. Analysing these models can accurately determine the volume and extent of illegal dump sites. Collaboration with experts in geoinformatics and photogrammetry is essential for the effective use of these technologies. Creating 3D models and mapping terrain not only assists in detecting illegal activities but also provides evidence in criminal proceedings. Law enforcement agencies within the EU, in addition to direct collaboration with experts in the field, have recently been developing their own capacities and specialists capable of utilising unmanned means to document crime scenes. The use of in-house capacities significantly reduces the time and financial requirements of collaborating with external expert organisations.

In conclusion, it can be stated that modern technologies, especially the use of drones with lidar and photogrammetry, have had a revolutionary impact on the ability to detect and document illegal waste transport. Their precise and rapid data acquisition helps LEAs create the necessary evidence for the effective prosecution of perpetrators.

Slovak overview

In Slovakia, the specialised unit responsible for detecting and investigating crimes related to unauthorised waste handling, including those associated with illegal cross-border waste transport, is the Hazardous Materials and Environmental Crime Detection Division of the police forces' National Centre for Specialised Crime. Established on 1 February 2022, this dedicated unit ensures the detection, clarification and investigation of environmental crime and crimes related to the illegal handling of chemical, biological, radiological, nuclear and explosive (CBRNe) materials throughout the territory of Slovakia. In the documentation of environmental criminal activities linked to illegal cross-border waste shipments, this unit collaborates intensively with customs officers from Slovakia's Financial Administration, experts from the Ministry of Environment and inspectors from the Environment Inspectorate.

In 2019–2021, hundreds of cases of illegal waste transport into the territory of Slovakia were identified and documented by the Slovak police. In 2022, thanks to very effective collaboration with the Slovak Financial Administration and Ministry of Environment, only five cases were documented. The decline in these criminal activities is attributed to direct and decisive measures taken by the Slovak police against companies organising illegal cross-border waste shipments, receiving waste from these shipments, operating waste processing facilities or using fuel made from waste from these shipments. Key to improving the situation were the specialised training of the police and the utilisation of specialised technical devices designed to monitor the content and quantity of waste transported by freight vehicles.

It is important to note that the fight against criminal activities related to illegal cross-border waste shipments and illegal waste trade is annually prioritised within the framework of Empact. This topic was also an area of cooperation during Slovakia's presidency of the 'Visegrád Four', established in 1993 as a community of four central European states: the Czech Republic (now Czechia), Hungary, Poland and Slovakia. These states are currently the most vulnerable to illegal waste imports, primarily due to rising disposal and recycling costs in western European countries and the predominant use of waste disposal processes in central European countries. Effective cooperation among all states in Europe in the fight against such serious criminality is key to its eradication and ensuring a responsible, ecological and economically sustainable approach by individual Member States in the field of waste management at the national level (Kern, 2023b).

Figure 3.1 and 3.2. Illegal waste disposal sites. Source: The author.

In the fight against environmental crime, specialised units within the Slovak police employ various methods and technical means to detect and document such activities. During operational activities aimed at gathering initial information about environmental crime, UAVs are utilised for observing objects, individuals and items, especially in inaccessible terrain or areas where the discovery of covert operations is a concern. In the process of documenting crime scenes, UAVs are employed for photogrammetric or lidar scanning, with the goal of creating a 3D model of the crime scene, its geodetic surveying and, most importantly, determining its volume. Figures 3.1 to 3.3 show waste disposal sites resulting from illegal transboundary waste transport, where the photogrammetry method was used.

Figure 3.3 and 3.4. Illegal waste disposal site and data processing output. Source: The author.

Figure 3.5. Data processing output. Source: The author.

Figures 3.4 to 3.5. represent the form of data processing output obtained by capturing the crime scene using UAV and the photogrammetry method.

In conjunction with other scientific methods, volumes of waste stored underground were identified as part of the investigation using the geophysical method of dipole magnetic profiling, which is used to examine underground structures and rock properties based on their magnetic properties. It is frequently utilised in geological and geophysical surveys to locate various geological formations, explore mineral deposits or investigate underground water (Frankovská et al., 2010). Given its ability to detect changes in magnetic properties, dipole magnetic profiling can be a valuable tool for mapping and characterising underground structures. This method has a depth range of up to several tens of metres, making it applicable for mapping shallow structures (SÚRAO, 2024). In Slovakia, police officers are capable of modelling the waste deposition, determining the volume of buried waste up to a depth of 70 metres. Combined with surface surveying using UAVs, extensive evidential material is generated for criminal proceedings, presenting various layers, as depicted in the illustrations below.

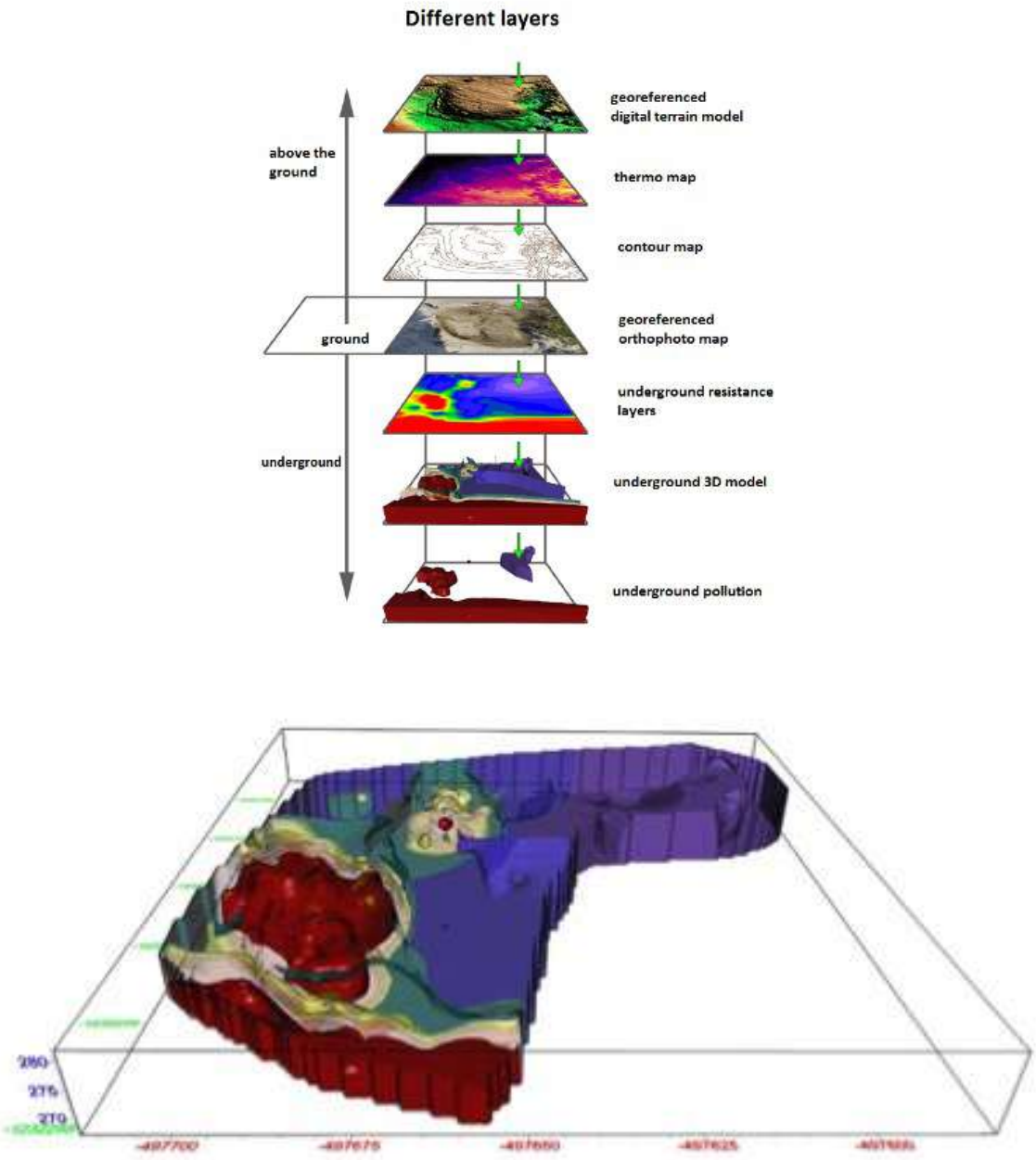

Figure 3.6. Generated various layers. Source: The author.

Another indispensable use of UAVs, especially in the context of illegal cross-border waste transport, is the monitoring of shipments directly at the site of their inspection. This involves verifying whether the declared waste being transported is indeed the subject of the controlled shipment. The modus operandi of illegal cross-border waste transport also includes the falsification of documentation, in particular altering the type of waste to align with existing legislation. For example, waste may be declared under catalogue number 19 12 04, which is a mix of plastics and rubber of a single polymer, and is on the green list. However, underneath the plastic waste in the cargo vehicle's storage area, municipal waste with catalogue number 20 may be found. The cross-border transport of this waste for disposal requires prior permitting. Visual inspection is sometimes insufficient to detect hidden and illegally transported municipal waste placed beneath a layer of plastic waste or mixed with waste declared in

accompanying documentation. It is important to note that, as waste classified under catalogue number 19 12 04 is on the green list, no prior approval from relevant authorities of the country of origin, transit or destination is required for its cross-border transport. By employing modern technologies, especially UAVs equipped with thermography, it is possible to directly identify, during on-site inspections, whether municipal waste is mixed or concealed in the declared shipment of plastics and rubber. This is because municipal waste generates heat, resulting from its biological decomposition or ongoing chemical reactions. In contrast, pure plastic waste does not induce such processes and, therefore, does not produce heat (Tansel, 2023).

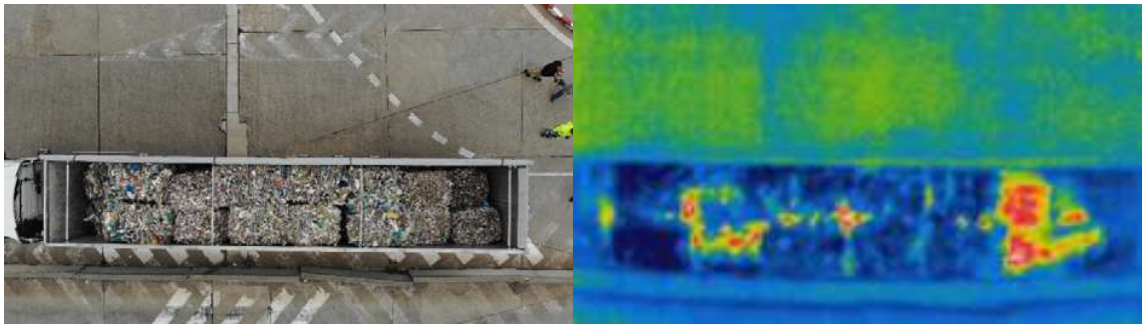

Figure 3.7 and 3.8. Waste shipment – using thermography. Source: The author.

In the thermal image above, the red areas can be identified as places where heat is being produced.

Challenges and perspectives in combating illegal waste transport

Illegal waste transport has become a global issue that requires coordinated efforts from multiple countries. Complications in investigating these cases arise from the different legal systems and diverse approaches to addressing environmental crimes. Increasing advances in technology provide offenders with new opportunities for covert waste transport and minimising the traces left behind. The solution lies in new challenges for authorities responsible for detection and investigation, who should invest in the development and implementation of new technologies such as artificial intelligence (AI), big data analytics and enhanced sensory systems. These tools offer new means of identifying and tracking illegal waste transport.

An ongoing project serves as an example of these efforts – a collaboration based on a memorandum of understanding signed between the United Nations Office on Drugs and Crime and the Vittorio Occorsio Foundation in Italy. The project aims to improve the understanding of using AI and other new technologies to prevent and combat international organised crime, including identifying the most effective and suitable procedures and developing legal frameworks. A specific focus is on utilising AI and other new technologies to combat crimes affecting the environment, including international waste trade associated with international organised crime and other types of criminal activities such as economic crimes, corruption and money laundering. One of the activities carried out under the memorandum was an AI learning project focused on identifying waste types based on UAV footage (Fondazione Vittorio Occorsio, 2021).

Another prospective activity is raising public awareness of environmental crimes, which could motivate citizens to cooperate with law enforcement authorities. Education about the dangers and consequences of illegal waste

transport can lead to increased public engagement. Updating and strengthening legislation related to illegal waste transport, including the introduction of strict sanctions, could deter potential offenders. With specific measures and adjustments in legal, technological and social domains, the international community can make progress in combating illegal waste transport and contribute to environmental protection on a global scale.

Conclusion

The use of modern technologies (drones, 3D scanners, etc.) by LEAs in the field of illegal cross-border waste transport appears to be a necessity, given the rapid technological progress. From the experience of the Slovak police, it can be concluded that these are very effective tools, even in the phase of detecting this illegal activity. Of course, these are financially demanding operations, as the acquisition of the appropriate technology and the training of operators represent a one-off higher investment from a financial perspective, the return of which, however, can be expected in a very short time. By quickly detecting illegal waste shipments, subsequent environmental damage or the costs of removing waste from an improper storage location, which would have to be borne by the destination country of the illegal cross-border waste shipment, can be avoided. Ensuring adequate technical equipment as well as training and specialisation of domestic authorities that detect, investigate and prosecute environmental crimes or make decisions about them requires the new Directive (EU) 2024/1203 of the European Parliament and of the Council of 11 April 2024 on the protection of the environment through criminal law, replacing Directives 2008/99/EC and 2009/123/EC. The specialisation of LEAs, their expertise and quality technical equipment are, therefore, key tools in the fight against environmental crime.

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