



CHARACTERISTICS OF ILLEGAL DUMPING SITES – CASE STUDY: WATERCOURSES

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Summary

Illegal waste deposition in places unadapted for this purpose poses a hazard to the natural environment. Each year over 10 000 illegal dumping sites are liquidated in Poland. The areas where illegal landfills occur are most frequently situated in the vicinity of waste management plants, wastelands, roadsides, byways or unfenced private plots (particularly on the city outskirts), forests and water courses. Despite of the changes introduced in recent years in the system of municipal solid waste management in Poland, which in the first place aimed to prevent formation of illegal dumps, such places still arise causing pollutant emission into the atmosphere.

The aim of the paper was conducting an analysis of the existing illegal dumping sites in Krosno commune (Podkarpackie voivodship). The investigations were conducted along the selected stretches of the Wisłok and Lubatówka rivers. The analyses were carried out in three measurement series during the period from March to October 2014. As results from the analyses, new illegal dumping sites arise all the time in the water courses in Krosno city and a majority of them can be easily identified in this area. Glass and plastics have the biggest share in the morphological composition of the waste deposited on them. Illegal dumps differ with their area and dispersion of waste. It is worth noting that several of those were identified directly in the water course.

Keywords: waste management, illegal dumping sites

INTRODUCTION

The Act on the maintenance of communes in a clean and orderly condition (Act, 2015) revolutionised Polish law system concerning the proceeding with municipal solid waste. Communes took over a responsibility for waste and their management. Introducing a new system of waste management in Poland was supposed to bring numerous tangible benefits, including among others: sealing the system, raising ecological awareness among the society, increasing the degree of biodegradable waste recovery and reducing the problem of illegal landfills (Malinowski 2011). However, introducing the law did not solve the problem. Despite the fact that all inhabitants of Poland pay a fee for waste management, new dumping sites arise all the time. Municipal Cleaning Service in Krakow states, that illegal waste landfilling applies mainly to: furniture, waste electrical and kitchen equipment, debris and other building waste. In September 2013 (after the new system was implemented) Municipal Cleaning Service in Krakow removed 150 dumping sites in the city of Krakow and its environs. A similar number of interventions was registered the previous year (2014), when the provisions of the Act (2015) were not yet in force. During the period from January to March 2014, two hundred eighty eight illegal dumps (with a total volume of 1300m³ waste) were removed in Krakow (MPO, 2014).

Removal of illegal dumping sites is an ongoing process. They arise because of a lack of Selective Municipal Waste Collection Points or the household waste recycling centers. Such places have not been establish so far in the area of about 30% of communes in Poland (Wojtczak, 2015). Moreover, illegal deposition sites reappear all the time in the same places, because of the local communities are used to leaving (dumping) waste in the usual places. Table 1 presents the data accumulated by the Central Statistical Office (CSO) about illegal dumping sites for the years 2011-2014.

The newly arising or existing illegal dumping sites pose a potential hazard of serious pollution. Unlike the orderly municipal landfills, they are totally unprotected. There is neither a geomembrane layer separating them from the substratum, nor waterproof sealing, nor separate protection zone (Kaszubkiewicz *et al.* 2011).

Illegal dumping sites arise most frequently in the vicinity of waste management plants, wastelands, roadsides, byways, unfenced private plots (particularly on the city outskirts), in forests and by the water courses. The presence of illegal deposition sites is strictly connected with waste management system implemented in a commune and the living standards of its inhabitants. Brach and Wiśniewski (2012) noticed that the illegal waste dumping takes place mainly in the forest areas because these are secluded places. Unlicensed landfills are located particularly on the edge of a wood, in the area bordering on arable field

or a meadow, along a stream (also partially immersed in water or occasionally flooded), along tourist routes and roads, and to a lesser extent in the vicinity of buildings (Kolanowski and Wisniewski 2012). National Parks and Natura 2000 areas are not free from illegal dumping sites, either. Gajda and Plaza (2008) report that 250 illegal dumping sites were found in the years 2005-2006 in the area of the Ojców National Park. Evident (3.5 –fold) increase in the number of these places in comparison with 1995 is most disturbing (at that time there were 72 in a much smaller National Park area). Waste were found also in places where their presence is unacceptable, e.g. in the proximity of potable water intake for people, as it poses a hazard to drinking water quality (Gajda and Plaza 2008).

Table 1. Summary of data about the removed and existing illegal dumping sites in Poland in the years 2011-2014

No.	Specification	Unit	Years			
			2011	2012	2013	2014
1.	Number of removed illegal dumping sites	pcs.	13202	10623	15178	12707
2.	Total waste mass removed from illegal dumping sites	Mg	52 629	84 963	102 485	46 600
3.	Number of identified illegal dumping sites in existence by the end of the year	pcs.	2539	2334	2791	2371
4.	Area of identified illegal dumping sites in existence by the end of the year	ha	252	250	220	167

Source: CSO (2012, 2013, 2014, 2015a, 2015b)

Illegal dumping sites are a source of threat resulting from migration of toxic substances from deposited waste (or leachates) into the soil profile (Filipiak *et al.* 2007), but also due to blowing and settling of dusts from this place (Golimowski *et al.* 2003). Illegal dumping sites are also the source of the soil pollution with heavy metals (Kaszubkiewicz *et al.* 2011). Elevated concentrations of copper, nickel, zinc, chromium and mercury were registered in in the soil in their vicinity (Niedźwiecki *et al.* 2003, Kanecka-Geszke 2005). Spreading of pathogenic microorganisms carried by birds, rodents and other small animals, which seek food in such places, is particularly dangerous. The contact of waste with shallow ground water is facilitated. Moreover, both surface and underground waters may be polluted. Waste dumped by watercourses may affect proper water flow and increase the flood hazard. Illegal deposition of waste on river banks may threaten the habitats of the species living there.

Krosno commune organizes actions during which local dwellers identify and clean the illegal dumping sites. One of such initiatives is “Clean Wisłok River“ action initiated in 2011. Anglers and people living by the river help to

clean the river. Between several and more than a dozen illegal dumping sites are found during each of these actions. CSO information about the illegal dumps in the Krosno commune for the years 2010-2013 was compiled in Table 2.

Table 2. Summary of data about the removed and existing unlicensed landfill sites in Krosno in 2010-2013

No.	Specification	Unit	Years			
			2011	2012	2013	2014
1.	Number of removed illegal dumping sites	pcs.	6	4	1	3
2.	Total waste mass removed from illegal dumping sites	Mg	18	22,5	68	82
3.	Number of identified illegal dumping sites in existence by the end of the year	pcs..	4	5	4	1
4.	Area of identified illegal dumping sites in existence by the end of the year	ha	380	425	370	250

Source: Own studies based on CSO (2015b)

The main objective of conducted investigations was identification and characterisation of the places where illegal dumping sites occur along the Wisłok and Lubatówka rivers in Krosno city (Podkarpackie voivodship). The investigations covered a 7 kilometre long Wisłok river stretch and 1.5 kilometer of Lubatówka river stretch within the administrative boundaries of Krosno city.

MATERIAL AND METHODS

The Wisłok river is the largest right bank tributary to the San river. The river is 204.9 km long and its catchment area covers 3528.2 km². A part of the catchment is under legal protection as a part of Jasło Landscape Park and Czarnorzecko-Strzyżowski Landscape Park. The Wisłok river is a receiver of municipal and industrial sewage and sewage from rural areas. Its water is taken for municipal and industrial purposes, among others for Krosno city. The Lubatówka is a stream in the Beskid Niski Mts, a left bank tributary to the Wisłok. The river length is 25.7km, whereas its catchment area covers 89km².

The field investigations were conducted in 3 measurement series in March, July and October 2014. Each analysis was performed for the same river stretches. Observations were conducted in the morning at good visibility. Each visible concentration of waste with an area exceeding 1m² was regarded as an illegal dumping site. Identified sites were cleared of the waste. In the 2nd and 3rd series of analyses, the places where the presence of illegal dumping sites were previously noted, were analysed in the first place. Information was collected by means of

a specially developed form acc. to the pattern by Kruczek (1987), modified by Gajda and Plaza (2008). Analysis of the identified illegal dumping sites was conducted according to the guidelines developed by Zabłocki *et al.* (2011).

Inventory works comprised:

1. localization of the dumping site and recording the place on GPS receiver,
2. filling in the form determining among others: topographic features of the dumping site place (riverbed, floodplain, upper floodplain, on the slope), relationship of the illegal dumps to the water table, assessment of the appearance (dispersed or concentrated), the age (including possible reappearance in the same place) and visibility (hidden or visible from afar),
3. listing the illegally deposited waste (biodegradable waste, metal, glass, plastics, paper and cardboard, composite waste (Tetra-Pak), textiles, wood, large volume waste (bulky waste), and waste electrical and electronic equipment, tyres, debris and other building waste, other waste categories and hazardous waste),
4. determining the proportions of dominating kinds of waste (with the accuracy to 5%),
5. determining the dump area (m²),
6. developing photographic documentation.

RESULTS AND DISCUSSION

26 illegal dumping sites with a total area of about 373 m² were found on the investigated terrain (Fig.1). The largest illegal dump covered the area of 60 m² and the smallest registered dumping site was 3.5 m². 55 bags of 120 dm³ with waste from 13 illegal deposition sites were collected during the first measurement, while during the second 17 bags were gathered from 7 illegal waste disposal sites (including 6 new ones and 1 located on a previously cleaned terrain), and the third measurement yielded 19 bags of waste from 6 dumping sites (including 5 new ones and 1 located on previously cleaned place). Identified illegal dumping sites were localised directly in the watercourse (the waste were stopped by branches or stones) or on a slope in the river channel (Fig.1). Only the first measurement revealed four cases of illegal dumping sites located on a flat terrain, at the distance of 15-30 metres from the riverbed. Among the 26 identified unlicensed dumping sites, 20 were well visible from a distance.

The most numerous places of illegal waste disposal were identified and analysed during the first measurement. The waste collected on illegal dumping sites revealed a diverse morphological composition, with dominating plastics, glass, metal and bulky waste. During the second and third series of research, the observation covered in the first place the sites where illegal landfills were found

previously. After removing waste from these places and installing city monitoring cameras in their vicinity, further investigations revealed a reappearance of only one dumping site at Ściegiennego street. Glass, plastic and metal containers again prevailed in its morphological composition. The largest dumping site, with the area of 31.5m² was situated directly in the Lubatówka river. It formed because of broken trees which stopped flowing municipal solid waste. 5 out of 6 illegal dumping sites identified during the third series of research were located directly in the water. Dumping sites with the area of below 10 m² dominated in this measurement. Selected parameters characterising dumping sites catalogued during the investigations were listed in Table 3.



Photo: Jastrzębski 2014

Figure 1. Illegal dumping sites located on the Wisłok river stretch

Table 3. Parameters of illegal dumps located during individual measurements

No.	Specification	Unit	1st measurement (March 2014)	2nd measurement (July 2014)	3rd measurement (October 2014)
1.	Number of identified dumping sites	pcs.	12 – Wisłok 1 – Lubatówka	2 – Wisłok 5 – Lubatówka	4 – Wisłok 2 – Lubatówka
2.	Total area	m ²	219	83	71
3.	Minimum area	m ²	4	3,5	4
4.	Maximum area	m ²	60	31.5	22.5
5.	Dominating landform	-	riverbed	riverbed	riverbed
6.	Appearance	-	dispersed	dispersed	concentrated

Source: Author's own studies

Waste originating from households prevailed in the morphological composition of the waste deposited by the analysed watercourses. Only on the largest

dispersed illegal dumping site, identified during the first series of investigations, it was visible that the waste deposited there did not originate from households. The waste found there contained mostly (over 50%) glass and (over 40%) metal alcoholic drink packaging. The largest proportion in the morphological composition of waste deposited on illegal dumping sites (in each measurement) was made up of plastics and glass (Table 4). In comparison with the other investigations, tyres, large volume waste and electrical and electronic waste had a low share. It is disturbing that a vast majority of identified waste should be collected selectively at Selective Municipal Waste Collection Points or at the household waste recycling centers. These waste may be reusable or fit for recycling.

In the third measurement series, an average share of construction and demolition waste exceeded 15 %. These waste were found on a big dumping site with the area of 27 m², the only one located outside a riverbed. Conducted analysis confirmed the observations of Zabłocki *et al.* (2011), who stated that PET and glass bottles and cans are deposited mainly on small illegal dumping sites, whereas chiefly debris, construction and demolition waste appear on larger dumping sites.

Table 4. Averaged morphological composition of waste deposited on the identified dumping sites

No.	Specification	1 st measurement (March 2014)	2 nd measurement (July 2014)	3 rd measurement (October 2014)
1.	Organic waste	5.2	7.6	1.4
2.	Plastics	28.2	30.2	22.9
3.	Glass	27.1	24.1	25.6
4.	Metal	8.8	10.1	7.5
5.	Paper and cardboard	2.8	2.8	1.6
6.	Wood	0.3	0.4	4.7
7.	Textiles	1.6	6.8	0.9
8.	Composite waste	0.9	2.9	4.6
9.	Tyres	5.1	1.1	1.4
10.	Debris	4.9	5.6	15.1
11.	Bulky waste, waste electric and electronic equipment	9.6	1.3	2.8
12.	Hazardous waste	0.4	1.1	1.8
13.	Other categories	5.1	6.0	9.7

Source: Author's own studies

Hazardous waste were identified on 20 of the investigated illegal dumping sites. Although they did not constitute a considerable proportion of the morphological composition, still they posed the most serious hazard to the environment. Like in the research conducted by Gajda and Plaza (2008), these were mainly paint and varnish packaging, eternit (asbestos plates), batteries and car batteries.

CONCLUSIONS

The analysis of illegal dumping sites conducted along the Wisłok and Lubatówka river stretches allows for the following conclusions:

- new illegal dumping sites appear all the time,
- only one illegal dumping site reappeared and was identified both in the second and third series of investigations, which should provide a basis for the installation of video surveillance system in this place,
- a majority of illegal dumping sites were easily identifiable in the field,
- glass and plastics prevailed in the morphological composition of the waste deposited on the illegal dumping sites and various kinds of packaging constitute the largest part. Their prevalence indicates that they originate from households.

The accumulated data allow to put forward proposals and suggestions aiming at the change of the state of Polish rivers. It seems that the relationship of costs involved in removing illegal dumping sites and the costs of waste collection should be analysed by the local governments. The monthly frequency of reusable waste collection should be increased to reduce the number of these waste. The reappearance of illegal dumping sites should be prevented by means of installing city monitoring cameras in the identified places. Another important measure is raising the ecological awareness among local dwellers, owing to a development of education and information system, financed by means, which according to the Law should come from the fees paid by local inhabitants.

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