

WASTE MANAGEMENT SYSTEM IN THE RIPARIAN TOWNS OF THE ROMANIAN DANUBE SECTOR

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Abstract. In Romania, managing and recycling household garbage is one of the least performing systems in the European Union. Numerous waste dumping sites are uncomformable to European standards, besides there is little garbage recycling. This paper makes a complex waste management analysis of the Romanian Danube riparian towns subjected to strong human pressure; this sector is also of great European interest for the protection of its biodiversity. The main dysfunctions of garbage dumping, the price asked by scavenging services, the steps taken for the ecological management of waste dumping sites in conformity with EU norms and better waste recycling, as well as future measures are also discussed in this paper.

Key-words: garbage, ecological dumping sites, recycling

1. Introduction

The challenges posed by environmental quality and protection in the early 21st century led to a new approach to the interaction between human society and the environment, society having to cope with new global issues like population increase, globalization, the economic crisis, climate change, loss of biodiversity and degradation of environmental quality (Gandy, 1994; Arnott *et al.*, 2008).

Socio-economic development and a higher living standard make it necessary to better protect the environment and its components (soil, water, and air) and be more careful with what pollutes them. One of the pollution sources is household garbage, which by quantity and dumping sites could become a great environmental risk, particularly for the fragile ecosystems (Verheij *et al.*, 2008; Baycan-Levent *et al.*, 2009).

In view of the above, the complex relationships among climate change, biodiversity, demographic pressure, use of resources and the quality of life enhance environment-associated uncertainty and risks. Therefore, the new EU-stipulated requirements and exigencies call for a modern approach to global environmental issues with highlight on the effects and pressure put by socio-economic development (Syrett and Sepulveda, 2012; Trentea *et al.*, 2014; Forsberg and Lindgren, 2015). EU provisions have in view three basic aspects: *to prevent waste yield* by improving production technologies and make consumers opt for less-polluting items; *policies of waste recycling and reuse* (wrapping paper, cars out of use, batteries, electric and electronic devices, etc.) to recover and *finally eliminate them*; if wastes cannot be recovered they should be eliminated in safe conditions for the environment and for people's health under a strict monitoring programme (Zebek *et al.*, 2015).

Proceeding from these goals, from the EU legislation, and from the local particularities, the new EU member-states and the candidate state have elaborated sustainable waste management models (Su *et al.*, 2011; Boadway *et al.*, 2013; Stefanovic *et al.*, 2014) to limit up to complete elimination the pollution produced by uncontrolled dumping and stimulate the share of recycled wastes. This implies raising population's awareness on the importance of preserving a clean environment on the one hand, and of implementing new technologies to reintroduce waste into the production cycle, on the other. At the same time, one should be very careful with the type of waste carried from collection to dumping sites lest accidental pollution along the route should occur (Egbu and Okoroigwe, 2014).

Therefore, the management of household waste in the riparian area of a big navigable waterway like the Danube, is particularly important not only for the cross-border implications of pollution in a zone of intense demographic pressure, but also for the effect of pollution on the fragile natural ecosystems downstream this area e.g. the Danube Delta and the Natural Reserve Insula Mică a Brăilei.

Proceeding from the above considerations, the present study is aimed at highlighting dysfunctions in the overall management system of the Danube riparian towns (particularly in the lower sector of the River) in order to correct them in line with European standards. Moreover, having in view the importance of the Danube, both for the Romanian and the EU economies, the authors consider this analysis to be relevant for the study of domestic waste management systems in the riparian urban settlements of some cross-border waterways.

2. Material and methods

2.1. *The Romanian and European garbage management legislation*

The EU Acquis on waste management contains 16 normative acts, transposed in the Romanian legislation in the form of laws, Government decisions and Minister's Orders. The Romanian legislative framework includes laws No. 211/2011 on the waste regime, elaborated in conformity with the European Parliament & Council Directive No. 2008/98/EC (Waste Framework Directive) and No. 139/2002 on the approval of Government Ordinance No. 87/2001 on public scavenging services in localities, supplemented by Government Decisions No. 1,470/2004 on the National

Strategy for Waste Management and the National Waste Management Plan; No. 856/2002 on waste management evidence and approval of waste lists, inclusive of hazardous wastes; No. 349/2005 on waste storage and No. 870/2013 on the approval of the National Strategy for Waste Management 2014-2020; Government Orders No. 1,215/2003 on the approval of Technical Regulations on waste burning and No. 794/2012 on packing wastes data-reporting procedure. The National Waste Management Strategy 2014-2020 (NWMS) proposes a series of measures contributing to a good ecological and economic management. It was underlying the elaboration of the National Waste Management Plan (NWMP). This Plan stipulates that all waste dumps that do not meet national legal provisions shall be closed until 2017. These two documents were used in the elaboration of regional, county and master plans, as well as in waste management feasibility studies. In conformity with the Directive 2008/98/EC and its inclusion in the national legislation (Law No. 211/2011 regarding the waste regime), NWMS and NWMP were reviewed.

Out of the multitude of EU and Romanian legislative provisions, a synthesis of major targets had in view the prevention of waste generation and of the noxious effects of wastes; reusing wastes through recycling, or in any other way, to obtain by-product materials, or employ some categories of wastes as energy source; building and operating installations, implementing methods and technologies, designating sites and equipping them for the treatment, use and elimination of wastes in order to prevent impairment of the environment and of people's health; transport means suitable to the nature of carried wastes, homologated technologies

and installations to valorize wastes; organize programmes of population training and education in waste management; elaborate sectoral strategies and programmes of waste management and follow their implementation (National Waste Management Strategy, 2014-2020).

The decentralisation of waste management services implied distinct costs for the Danube riparian town-users. The investigations conducted by the authors in the Danube riparian towns during November 2015, revealed that the prices charged by the scavenging services operators varied between 2.46 and 8.40 lei/pers./month).

In many instances, although old dumps had been closed as stipulated by law, the shortage of conformable dumps made household garbage (especially in the countryside) be dumped on new, uncontrolled sites (Orlescu and Costescu, 2013).

2.2. Cross-border pollution and particularities of the Romanian Danube border sector

Cross-border pollution is generated by a physical source situated totally or partly in an area under the national jurisdiction of a state (the polluter), its effects prejudicing an area under the jurisdiction of another state (the polluted) (Geneva Convention, 1979). Such a situation presupposes either direct pollution, that is, air or water transport of some residual substances from one state to the other, or indirect pollution through the transport of impure agricultural or industrial products from one state to the other; hidden pollution is the result of placing some high-polluting industries, possibly without anti-polluting installations, on the territory of other states (which is more profitable), the pretext being

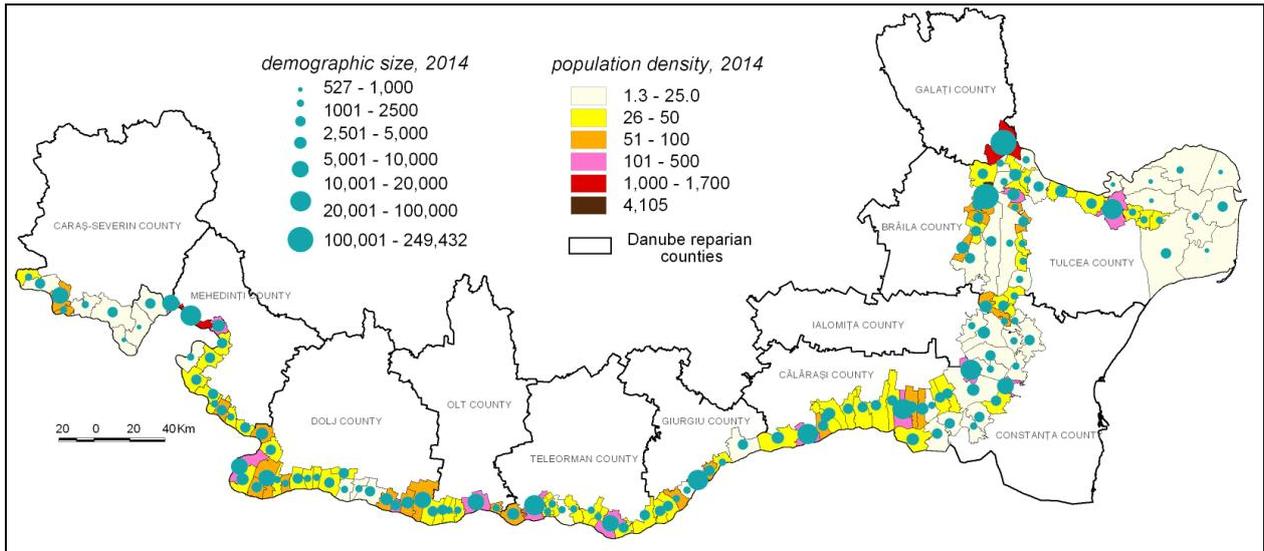


Fig. 2. Human pressure in the Romanian Danube sector

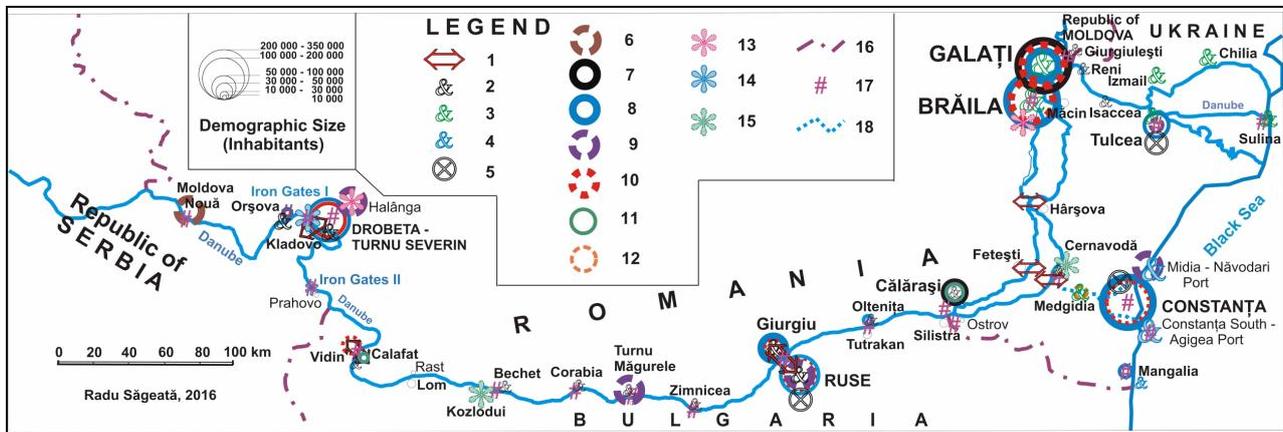


Fig. 3. Industry in the Lower Danube sector. 1. Bridges, 2. River harbours, 3. River-maritime harbours, 4. Maritime harbours, 5. Airports, 6. Copper ore extraction centres, 7. Iron-and-steel plants, 8. Shipyards, 9. Chemical and petro-chemical industries, 10. Building-materials industries, 11. Paper and cellulose industries, 12. Cement factories, 13. Thermal-power stations, 14. Water-power station, 15. Nuclear-power station, 16. Terrestrial borders, 17. Cross-border connections, 18. Danube – Black Sea Canal.

So, cross-border pollution has become ever more present, occasionally engendering tensions between Romania and some of its riparian neighbours (Bulgaria, Ukraine), because natural sites of national value lie alongside the Lower Danube sector (the Danube Delta Biosphere Reserve, the Iron Gate Natural Park, Djerdap National Park, the Natural Reserve Insula Mică a Brăilei, etc.).

The 127 Romanian Danube sector riparian settlements shelter 1,275,750 inhabitants (Census of Population and Housing, October 20, 2011).

The extensive demographic polarisation is visible in the distribution of population by two residential environments: urban, englobing 21 settlements (16.5% in all) with 932,466 inhabitants (73.1% of the population total) and rural, 106 communes (83.5% of all the Danube riparian administrative units) with only 343,284 inhabitants, that is 26.9% of the whole riparian population. The bipolar Galați and Brăila core numbered 429,734 inhabitants (46.1% of the whole urban population and 33.7% of the total Romanian Danube riparian inhabitants), and together with its two cross-border

connections (Reni and Giurgiuilești) they come to have over 450,000 inhabitants. Far down the hierarchical scale rank the towns of Drobeta-Turnu Severin, Tulcea, Călărași and Giurgiu with 100,000-60,000 inhabitants, all these towns representing cross-border systems of doublet settlements.

The oversized industrialisation policy promoted after the Second World War, turned the Romanian Danube sector into an important industrial-polluting polarisation axis: chemical units in Drobeta-Turnu Severin, Turnu Măgurele, Giurgiu, Brăila, Galați and Tulcea; the water-power plants Iron Gate I and Iron Gate II; thermal-power plants in Drobeta-Turnu Severin, Brăila and Galați; iron-and-steel plants in Galați and Călărași; nuclear power station at Cernavodă (Fig. 3). This industrialisation drive led to the functional diversification of settlement types (Fig. 4).

Another consequence was severe cross-border pollution (carried by the N-E and N-W winds) which, over the years, have several times tensioned Romanian-Bulgarian and Romanian-Soviet relations (Horlings and Marsden, 2014).

Following the post-1989 structural changes, the economic evolution of these Danubian settlements experienced a slowdown caused by the general decline of the Romanian economy, hence a lower volume of goods would cross the Lower Danube sector, industrial production in the port-towns of this sector declining; the dismemberment of the CMEA association of states meant an important loss of export markets, and a negative impact on the export-oriented industrial branches, iron-and-steel in particular; the dramatic reduction of investments in industry prevented the modernisation and retechnologisation of industrial units, maintaining a low labour productivity level. Besides, environment protection actions, putting pressure on polluting industries (chemical plants and ferrous metallurgy), obliged them to restrict production in order to meet pollution standards (Angelo and Wachsmuth, 2015; Legras, 2015).

On the right-hand side of the River, that is in Bulgaria and Serbia, urbanization was not that intense (450,000 urban population), moreover they had no urban core comparable to that of Galați-Brăila in Romania.

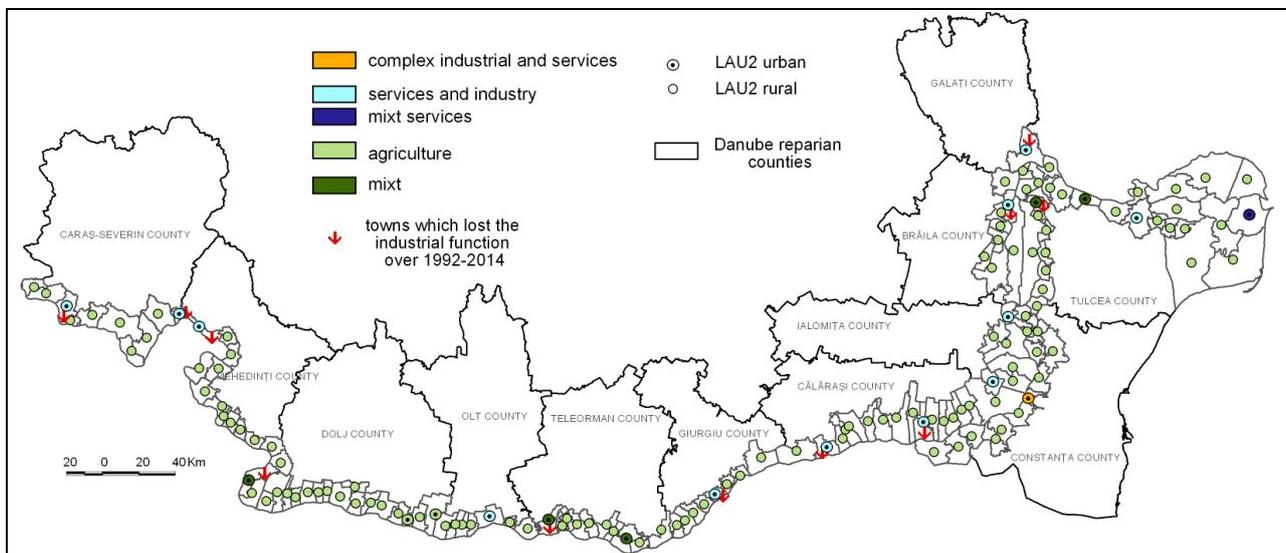


Fig. 4. Functional types of settlements in the Lower Danube sector

The only largest town with over 100,000 inhabitants was Ruse (149,600), next in line coming Izmil (84,800), Vidin (48,100), Silistra, Svishtov, Kilia, Lom and Reni, each with more than 10,000 inhabitants. Some of the smaller settlements, yet important for the cross-border connections operational in the Romanian Danube sector, were Kladovo, Prahovo, Brza Palanka and Tekija in the Romanian-Serbian sector; Giurgiulești bordering on the Republic of Moldova, and Vylkove in the Romanian-Ukrainian Danube Delta sector (Perkmann, 2003).

The extent of demographic pressure in the Romanian Danube sector is indicated by the proportion of population in the Danubian counties (23.13% of Romania's inh.). These counties constitute the enlarged Danube-riparian border-zone, the very territorial unit covered by our integrated analysis of household garbage management systems in the Romanian Danube sector, because dumping sites are not placed on the administrative territories of riparian settlements, but in their neighbourhood (Ianoș *et al.*, 2012).

3. Results and discussions

3.1. Wastes collection in Romania between "traditional model" and current imperatives

Romania's EU membership has imposed a new set of regulations to the management of household waste conformable to the European legislation and the country's commitments to it. Despite some obvious progress in matters of legislation, Romania lags behind in meeting the deadline of implementing its commitments, a situation liable to money penalties. Another aspect is the slow-going implementation of legislation:

when Romania joined the European Union (2007), over 95% of the local authorities were not aware that legal targets of collecting and using empties did exist, although they were legally obliged to have the necessary infrastructure for selective waste collection (Trentea *et al.*, 2014).

Besides, the management system of domestic refuse was extremely precarious at the time: according to the National Institute for Statistics, only 54% of the country's population benefitted from scavenging services (80% in town and only 22% in the countryside), and municipal waste recycling rate was of 13.16% in 2013, growing by 12.1% versus 2007, the year of Romania's membership to the European Union.

Placing selective garbage cans has only partly corrected these deficiencies, as these cans were limited to collecting only certain types of waste (paper/box board, plastics/packings, PETs, and metalware), the collection of other types of waste, such as nylon/lycra textiles, with low-degrading potential, being almost inexistent, although some technological procedures to reintroduce them into the industrial circuit did exist in the world. Moreover, there is also uncontrolled waste collection: there are many situations when garbage cans, in which mixed wastes had been dumped, are emptied by unauthorised people who sell them at recycling points; there are also situations when these cans are seldom emptied, becoming sources of pollution, especially in the warm season (Alam and Bahauddin, 2015).

Romania is among the new EU-member states where most quantities of town garbage are dumped, recycling and reusing them representing only 2.6% in all (Platon *et al.*, 2015).

3.2. Household garbage dumping sites in the riparian settlements of the Romanian Danube sector

The legal framework for garbage dumping sites, exploitation and monitoring of new sites, as well as exploitation, monitoring and closing down old uncomformable sites is provided by the Government Decision No. 349/2005. In order to implement the European Council Decision No. 1999/31/EC concerning dumping sites, Romania was given a period of transition until July 2017 for the stagewise closure of 101 uncomformable sites (see the data reported by the Ministry of Environment, Waters and Forests).

According to the National Waste Management Strategy, new, modern, waste management systems were to be created in both town and countryside, at county or regional level; the location of new ecological sites has to comply with general and local urbanistic planning, must not be located in flood-prone areas or protected natural areas, in the vicinity of harbours and free zones. The distance between the dumping site and the residential areas has to be of at least 1,000 m; zonal ecological sites should have a dumping capacity for at least 150,000 inhabitants; a dumping site should be exploitable for minimum 20 years.

City waste is collected by authorised garbage collecting firms, the local authorities having the responsibility of contracting such firms (Law No. 139/2002 on the approval of Government Ordinance No. 87/2001 regarding public scavenging services in localities). In the rural area, garbage collection from the population and the business sector is organised only in the settlements neighbouring some towns.

The normative acts in effect name three stages (2006-2009, 2010-2012 and 2013-2017) in which uncomformable waste deposits should be closed down. A number of nine sites were shut in the first stage (2006-2009), another six in the second stage (2010-2012) and five more continue to be operational until 2017 (Table 1).

Tulcea is the only county in the study-area where two dumping sites (at Măcin and in Sulina), uncomformable to environmental norms, are still operational. Closure deadline for the Sulina sites (15,000 m³) is 2017. Transferring household garbage from Sulina and from the other Danube Delta settlements to the conformable site which is to be built at Mihai Bravu, requires adequate transport infrastructure and garbage transport facilities. Only little of the garbage produced by the Danube Delta settlements is collected selectively by the Public Services Administration of Sulina and by the Local Council of Sfântu Gheorghe. In 2004, the Administration of the Danube Delta Biosphere Reserve initiated a public awareness educational programme that is still going on; also more selective PET collection garbage cans were placed on the main Delta tourist routes and two PET tamping presses were located in Sulina and at Sfântu Gheorghe. Another project launched by the DDBR was to raise people's awareness on the danger posed by wastes to the deltaic environment and to people's health.

The only county in the Romanian Danube sector without any ecological dumping site is Călărași, the homonymous town using Slobozia site (Ialomița County), Oltenița town resorting to Glina site (Ilfov County).

Table 1. Household garbage and scavenging services prices in the Romanian Danube riparian towns

Town	County	Population (2011 cens. data)	Unconformable closure year	Ecological dumping site location	Town distance to ecological site (km)	Tariff lei/pers./month	Tariff lei/pers./km/month
Moldova Nouă	Caraș-Severin	12,350	2012	Lupac	91	4.10	0.045
Orșova	Mehedinți	10,441	2009	Izvorul Bârzei	39	6.20	0.159
Drobeta-Turnu Severin	Mehedinți	92,617	2009	Izvorul Bârzei	11	2.46	0.224
Calafat	Dolj	17,336	2010	Mofleni ¹	90	No data	No data
Bechet	Dolj	3,657	2008	Mofleni ¹	69	4.50	0.065
Dăbuleni	Dolj	12,182	2009	Mofleni ¹	79	No data	No data
Corabia	Olt	16,441	2017	Bălteni	74	7.44	0.101
Turnu Măgurele	Teleorman	24,772	2007	Mavrodin	58	4.55	0.078
Zimincea	Teleorman	14,058	2007	Mavrodin	57	6.67	0.117
Giurgiu	Giurgiu	61,353	2007	Frătești	14	6.00	0.428
Oltenița	Călărași	24,822	2012	Glina	57	6.20	0.109
Călărași	Călărași	65,181	2012	Slobozia	45	6.97	0.155
Fetești	Ialomița	30,217	2007	Slobozia	63	5.07	0.080
Cernavodă	Constanța	17,022	2012	Ovidiu	70	5.04	0.072
Hârșova	Constanța	9,642	2010	Ovidiu	74	5.04	0.068
Brăila	Brăila	180,302	2006	Siliștea (Mucnea)	14	7.00	0.500
Galați	Galați	249,432	2011	Tirighina (Barboși)	7	4.67	0.667
Isaccea	Tulcea	5,026	2009	Mihai Bravu ²	49	No data	No data
Măcin	Tulcea	8,245	2016	Mihai Bravu ²	61	No data	No data
Tulcea	Tulcea	73,707	2015	Vărărie	4	7.67	1.917
Sulina	Tulcea	3,663	2017	estul orașului	7	5.00	0.714

1 Mofleni – component settlement of Craiova Municipium. 2 Mihai Bravu – dumping-site under construction.

A new EU-funded ecological site is to be built at Ciocănești (Călărași County). Until then, the transfer platform operational in Călărași will reduce the environmental impact of uncontrolled dumping sites.

Similarly, the unconformable dumping site in Oltenița was closed in 2012, and a transfer platform was built instead. Until the Ciocănești site will be commissioned, the town's household garbage is carried to Glina dumping site.

The town of Brăila, complying with EU regulations, has a first ecological site since 2002.

The distance between garbage collection points and dumping sites (Fig. 5) is the main criterion that should be reflected in the price of scavenging services. It appears that the inhabitants of Galați and Sulina are favoured in this respect, because the ecological sites lie within the town bounds, at some 7 km from the garbage collection points. At the other end stands Moldova Nouă, the town's dumping site being in Lupac Village, 91 km away (Table 1). The unconformable site in town had to be closed down in 2012. Caraș-Severin County has an integrated Waste Management Centre (a central ecological dumping site, a sorting station and a mechanical-biological treatment station).

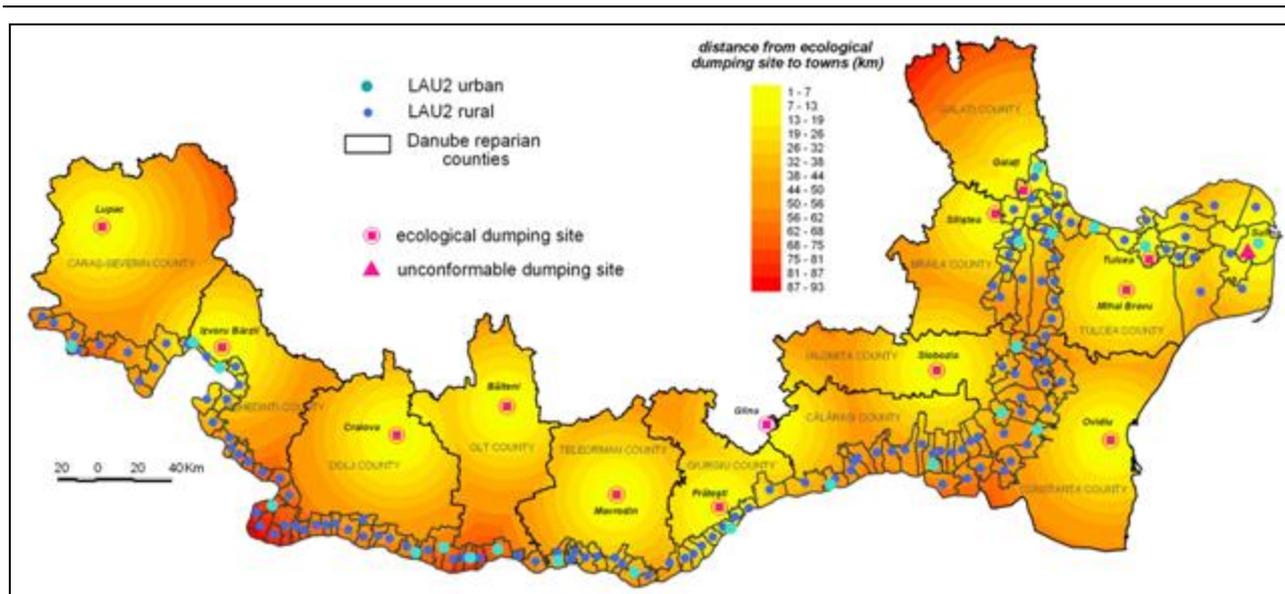


Fig. 5. Location of ecological dumping sites to serve the Romanian Danube Valley riparian towns

Shorter distances (under 20 km) between town and dumping site have also other county-seats: Drobeta-Turnu Severin, Brăila and Giurgiu, with over 50,000 inhabitants each, which produce huge quantities of household garbage.

Towns situated at a great distance from ecological sites are in the counties of Dolj (Calafat, Bechet and Dăbuleni), Olt (Corabia) and Constanța (Cernavodă and Hârșova). In Dolj County, Mofleni is the only ecological site authorised to receive the garbage collected from the whole county.

The household garbage of Cernavodă and Hârșova is carried to the ecological dumping site in Ovidiu Town, where a waste collection centre is scheduled to be built.

Transport and dumping costs in Drobeta-Turnu Severin and Tulcea range from 2.46 lei/pers./month to 7.67 lei, respectively (Table 1). The charge for the distance covered by the garbage transport operator is only partly reflected in the price of scavenging services, the towns lying at the shortest distance (up to 7 km) to the dumping sites pay twice the price

(4.67 lei/pers./month in Galați and 5.00 in Sulina) than that practiced in Drobeta-Turnu Severin (2.46 lei/pers./month), which lies 11 km away, and even higher than that practiced in Turnu Măgurele and at Bechet, towns that lie 58 and 69 km away, respectively.

In order to better illustrate the share of expenses for the transport of household waste from collection site to dumping site, the price to be paid was calculated by kilometre of transported waste. Prices vary widely, from 0.045 lei/pers./km in Moldova Nouă town and 1,917 lei/pers./km in Tulcea town, due to the local monopoly established by scavenging companies (Su *et al.*, 2011).

The uncomformable dumping site in Drobeta-Turnu Severin was closed in August 2009. After the dumping site situated in Șimian Commune, near the Topolnița River, was closed and turned ecological, a new ecological site began being built, the first module was commissioned in 2011. This dumping site lies on the territory of Izvorul Bârzei Commune (Halânga Village) in the vicinity of Drobeta-Turnu Severin. The

site (19 ha) is conformable to European standards, being equipped with all the necessary facilities.

The distance between Brăila City and Muchea dumping site is of only 14 km, yet the price practiced by the operator is of 7 lei/pers./month, which is some of the highest in all the 21 Danube riparian towns. At the same time, people in Moldova Nouă, a town lying 91 km away from the site, pay only 4.10 lei/pers./month (Table 1).

3.3. Selective waste collection and recycling

Selective recycling in Romania targets only paper, boxboard, metal, plastics and glass items, waste collection going on also in public institutions in order to support the implementation of Directive 2008/98/CE of the European Parliament regarding wastes; the deadline for all EU-member states to recycle at least 50% of all the quantity of waste is the year 2020 (Wolfson and Frisken, 2015). Romania occupies the last position in this respect, it recycling 2.6 % compared to over 50% in the EU-member states from Central and Western Europe (Germany, Austria, Belgium and The Netherlands) and ten times less than its neighbouring countries (Bulgaria: 28.5%, Hungary: 26.4%) (Eurostat. European Statistics, 2015).



Fig. 6. Selective collection cans (Photo: Radu Săgeată, 2015)

Since January 2014, selective waste collection in Romania is compulsory, the local authorities having been obliged to implement separate collection systems for certain categories of wastes (only for paper, metal, plastics and glassware) (Fig. 6).

Fairly good results registered the collection and recycling of plastics, some towns (e.g. Brăila) having initiated PET collection pilot projects. However, not all towns have special waste-processing centres. Recycling installations are usually located in towns with a large population which are also high plastics-wastes producers. The products obtained from waste recycling should have lower prices than those processed from raw materials.



Fig. 7. Selective collection afferent to a super-market point (Photo: Radu Săgeată, 2015)

Super-market networks have lately set up their own recycling systems (for plastics,

aluminium bottles, batteries and large domestic devices) (Fig. 7).

Even so, the quantity of PET recycling in Romania is reduced compared to the EU. Western states, recycling consisting in breaking up plastics pickings (by specialist firms) and subsequently exporting them to factories abroad which have the complete recycling technology.

Rather few firms in these towns are specialised in recycling glassware, boxboard and plastics. There is one firm for boxboard collection in each of the counties of Brăila (located in Brăila City), Călărași (in Călărași Town) and Mehedinți (in Drobeta-Turnu Severin Town); plastics collection: one firm in Călărași County (Oltenița Town), obviously limiting competition, hence higher services costs. At the same time, trading companies, authorised to valorise paper/boxboard and plastics, exist in each county, with the exception of Teleorman, Giurgiu, Călărași and Brăila, where collecting firms valorise glass wastes in the close neighbourhood, that is in Bucharest City, Galați and Vâlcea counties.

4. Conclusions

In each Danube riparian county, projects for the integrated management of solid wastes stimulate a sustainable waste management development system to reduce environmental waste impact and close down dumping sites unconfomable to EU standards.

Romania lags far behind the European countries in implementing its waste management commitments, many urban settlements still missing ecological waste platforms; in the countryside, wastes are dumped on the sites singled out by the local councils, which are not in

conformity with EU standards, nor are they authorised either.

Waste collection is another problem. Although selective collection has begun in many towns, yet the population is slow in complying with it. An important task in changing people's mentality devolves on non-governmental institutions which should involve the youth in environment protection actions.

In Romania, the implementation of the EU policies in matters of waste management is inscribed in the National Waste Management Strategy 2014-2020 and the National Waste Management Plan, both documents, approved by Government Decision No 1,470/2004, stipulate the following strategic objectives: developing an institutional and organisational framework; raising decision-makers' awareness; stimulating preoccupations for reducing waste amounts; using all technical and economic ways and means for waste recovery and recycling; developing sorting methods and systems at the generating source and/or before dumping; developing waste treatment technologies and facilities in line with EU and national regulations, as well as technologies for ultimate waste disposal in conformity with European and national stipulations.

The EU-agreed stagewise implementation of selective waste collection in Romania is as follows: a) 2004-2006, experimentation (pilot projects and raising population's awareness; b) 2007-2017, expanding selective collection at national level; c) 2017-2022, implementation of selective collection in more difficult areas (collective dwellings, dispersed rural settlements, mountain regions, etc.).

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