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Evaluation of Financial Investment Effectiveness in Latvian Waste Management Regions

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Abstract. **The Author of this paper performs ex post feasibility analysis of Latvian sustainable waste management system in terms of new infrastructure development. As Latvia now is at the stage of development of new waste management strategies for 2014-2020, it is important to nalyse the actions, taken up to now since 1995, when the first steps towards the sustainable waste management, regional division and development were taken in Latvia**.

Keywords: **household waste, investments, sanitary landfills, specific indicators per capita, waste management regions.**

1. INTRODUCTION

In the 21st century, the sustainable management of municipal solid waste will become necessary at all phases of impact from planning to design, to operation, and to decommissioning. As a consequence, the spectrum of new and existing waste treatment technologies and managerial strategies has also spanned from maintaining environmental quality at present to meet sustainability goals in the future [1].

As stated in EEA (2010) report waste management has been a focus of EU environmental policies since the 1970s. Such policies, which increasingly require the reduction, reuse and recycling of waste, are contributing to closing the loop of material use throughout the economy by providing waste-derived materials as inputs for production [2].

According to the report of Committee on the Environment, Agriculture and Local and Regional Affairs proper management of solid waste is a central pillar of far-sighted, sustainable environmental policies. Every European generates approximately 1 kg of solid household waste a day and the figures show an upward trend. Management of solid waste is therefore one of the major challenges currently facing local authorities [3].

The generated waste amount is increasing at rates comparable to economic growth. For example, both GDP and municipal waste grew by 19% between 1995 and 2003. One consequence of this growth is that despite large increases in recycling, landfill – the environmentally most problematic way to get rid of waste – is only reducing slowly [4].

Figure 1 shows the tendency of waste generation in European Union for the past 12 years. Even despite the European concerns on recycling and reuse, as in this time period many new countries joined the EU, and as this time period was characterized with extremely high economic growth, the overall ratio of waste generation has a positive tendency in comparison to 1995.

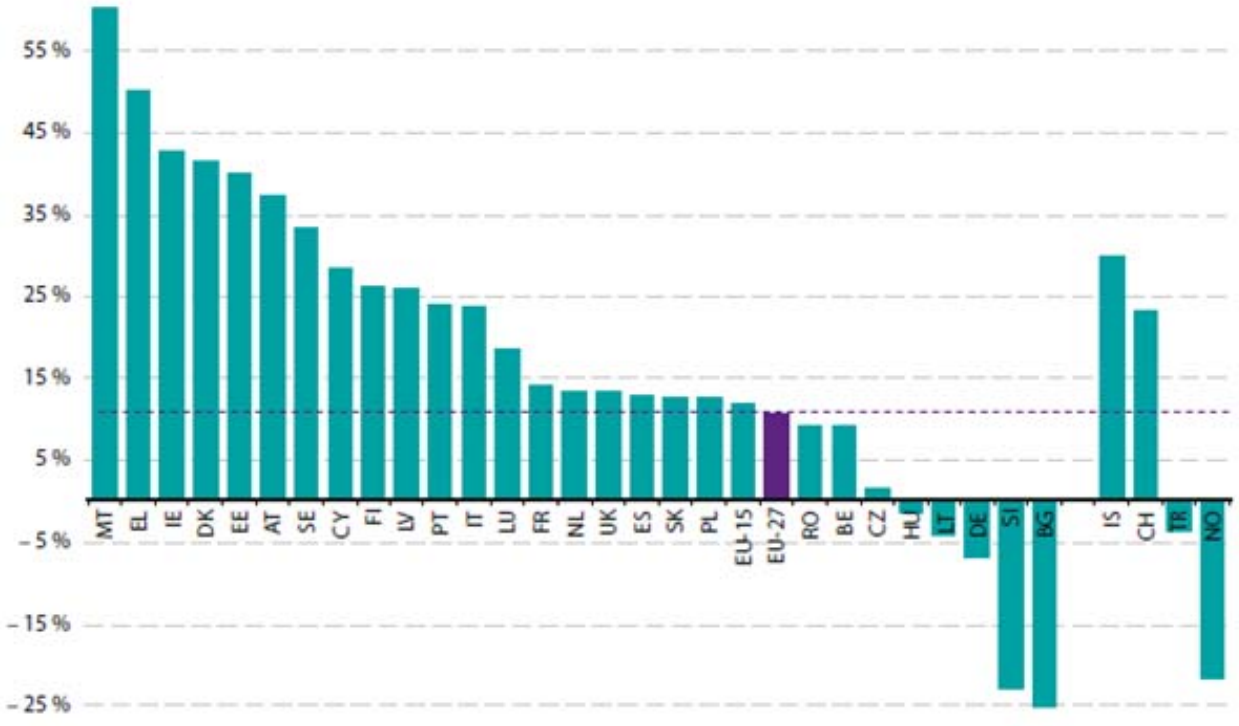

Fig. 1. Municipal waste generated 1995 and 2008 (% change)

Latvia has begun its way towards sustainable waste management in 1995, when first inventory of the whole country took place. Latvia's accession to the European Union required harmonization of existing legislation system with European and implementation of Sustainable waste management system [5].

In order to implement European Waste Management Directive, Latvia had to develop an integrated approach to municipal waste management. Latvian sustainable waste management system had three main stages:

1) involvement of 100% of urban and at least 75% of rural inhabitants;
2) implementation and development of sorted waste collection from 5% in 1995 to 25% in 2025;
3) development of new infrastructure – waste disposal and dumpsite recultivation.

First two stages inmplemented in the regions were monitored and controlled by the particular self-governments; and the financing for their implementation has been allocated from state and/or regional budget. Third stage involved recultivation of all existing dumpsites and construction of regional landfills. This stage required impressive financing and major part of it has been obtained from European Union Cohesion Fund (in the stage of Pre-accession – ISPA fund), the other part has been obtained from the self-governments.

II. Effectiveness of Adopted Investments n Regional Basis

In order to evaluate the effectiveness of the investments, the Author uses the data on overall investment per region and analyzes it on per capita basis.

Table 1 shows the financial flow and distribution of percentages among EU and local financing. It is clearly seen, that without European Union financing, these projects would not be feasible, as Latvia has faced a variety of problems for financing all these projects, taking into consideration, that the State co-financing was only 34%.

Though, it is vital to mention, that non of the projects would be financed if their financial NPV (FNPV) resulted > 0 with only local financing, as this is European Policy, to finance those projects, which are necessary in the society, but cannot be viable with local financing.

Total estimations of all ten projects (excluding Riga region, but with Viduskurzeme region) were 43 000 000 EUR (prices of 1997) [6], but as it is seen from table 1, the real investments reached 97 000 000 EUR, which shows significant underestimations in calculations.

When analyzing the changes in the number of inhabitants and waste generation amounts for years 2000 and 2009, it can be concluded, that most dramatic decrease of number of inhabitants is noted in Riga and Pieriga region – 9%, as major number of inhabitants live there, significant decrease is also noted in Austrumlatgale and Piejura regions, 8% and 15% respectively. Along with decrease of number of inhabitants, amount of waste generated also has decreased in the time period 2000 – 2009. This decrease reached 20%. It is partially explained with the migration of inhabitants but it is also explained with implementation of sorted waste collection, waste recycling and regeneration.

Taken as a basis data on number of inhabitants in each region, obtained from Regional Plans and Central Statistical Bureau, for the years 2000 and 2009, the Author has calculated the initial and de facto investments per capita in each region.

The results can be seen in the Table 2. From this table it can be noted, that due to the decrease in population, all the regions have expected increase of investments per capita, excluding two regions Liepaja and Ventspils, due to disbanding of Viduskurzeme region and uniting its territory to the abovementioned regions.

TABLE 1
REGIONAL INVESTMENTS

Region	Overall investments	% CF financing	CF financing, EUR	% Latvian financing	Latvian financing, EUR
Austrumlatgale	5 830 149	75%	4 332 369	25%	1 497 780
Dienvidlatgale	6 905 577	65%	4 488 625	35%	2 416 952
Maliena	9 155 892	65%	5 925 433	35%	3 230 459
Ventspils	6 065 745	49%	2 972 215	51%	3 093 530
Liepāja	8 084 915	63%	5 093 496	37%	2 991 419
Rīga	$25 210 000	0%	Financing of World Bank, Sweeden, WEFF, Riga, Beneficiary		
Piejūra	23 778 144	67%	15 951 632	33%	7 826 512
Zemgale	8 852 908	70%	6 147 881	30%	2 705 027
Ziemeļvidzeme	8 063 906	75%	6 031 734	25%	2 032 172
Vidusdaugava	19 924 145	65%	12 925 511	35%	6 998 633
Total (excl. Rīga)	96 661 381	66%	63 868 897	34%	32 584 584

TABLE 2
CALCULATIONS OF INVESTMENTS PER CAPITA AND CF INVESTMENTS PER CAPITA

Region	Investment per capita, EUR (initial)	Investment per capita, EUR (de facto)	Change, EUR	CF investment per capita, EUR (initial)	CF investment per capita, EUR (de facto)
Austrumlatgale	47.50	51.42	3.92	35.30	25%
Dienvidlatgale	30.34	30.93	0.59	19.72	35%
Maliena	99.53	103.31	3.78	64.42	35%
Ventspils	104.58	74.64	-29.94	51.25	51%
Liepāja	60.34	48.07	-12.27	38.01	37%
Rīga	26.88*	29.44*	2.56	0.00	
Piejūra	148.99	174.29	25.3	99.95	33%
Zemgale	45.44	46.80	1.36	31.56	30%
Ziemeļvidzeme	42.30	43.17	0.87	31.64	25%
Vidusdaugava	153.07	165.89	12.82	99.30	35%

Viduskurzeme region is the only region, which was not formed due to the political issues. The local governments had difficulties in institutional issues and it was decided to unite the region with two already existing – Ventspils and Liepaja.

The Figure 2 shows, that the Regions, mostly affected by the decrease of number of inhabitants are Piejūra, Vidusdaugava and Maliena.

Author has used de facto investment per capita ratios and states, that the least per capita financed region resuled to be Dienvidlatgale, but the highest investments per capita are in Piejura and Vidusdaugava regions. It is clearly seen from the Table 2, that in each region, excluding Ventspils, the volume of Cohesion Fund financing significantly exceeds the volume of local financing. Riga is excluded from this figure, as it was not financed from the Cohesion Fund.

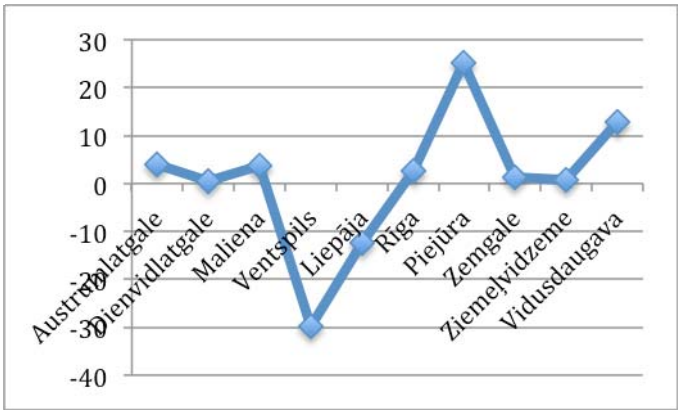

Fig. 2. Change of investment per capita, EUR

TABLE 3
CALCULATIONS OF RECULTIVATION AND LANDFILL INVESTMENTS PER HA

Region (in operation since)	Recultivation, ha	Landfill, ha	Recultivation investments, EUR	Landfill investments, EUR (*-USD)	Recultivation investments per ha, EUR	Landfill investments per ha, EUR (*-USD)
Austrumlatgale (2007)	33	13	979 614	3 697 160	29 958	284 397
Dienvidlatgale (2007)	29	11	928 352	4 449 485	31 793	423 760
Maliena (2008)	76	15	3 969 062	5 677 783	52 224	378 519
Ventspils (2004)	17	30	867 344	3 678 544	50 135	122 618
Liepāja (2004)	45	29	2 224 533	2 467 916	49 434	84 837
Rīga (2005)	20	87	-	25 210 000*	-	289 770*
Piejūra (2009)	75	15	3 418 122	8 970 847	45 539	598 056
Zemgale (2008)	30	8	1 220 014	5 603 010	40 398	700 376
Ziemeļvidzeme (2005)	15	12	776 853	4 004 053	51 790	33 3671
Vidusdaugava	120	20	4 304 743	4 995 675	35 873	249 784

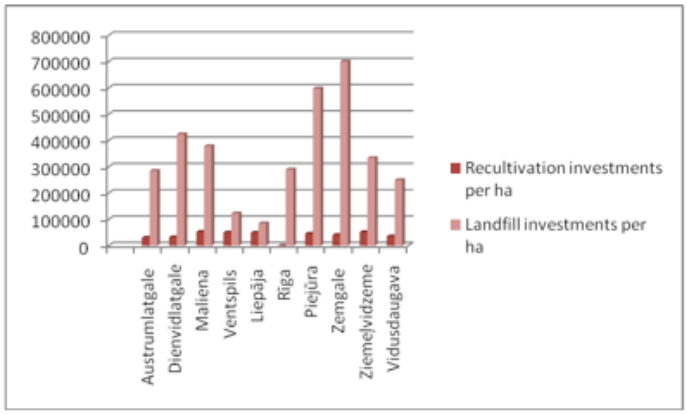

Fig. 3. Landfill and recultivation investments per ha

Table 3 shows that the largest landfill investments are in Riga region, but this is explained by the population density, as approximately 1 mln., of inhabitants live in Riga and Pieriga region that is why the biggest and most expensive landfill is situated there. Second largest landfill investments and landfill investments per ha are in Piejura region that is mainly due to the fact, that the project was launched in the period of the major economic growth and the prices for the construction were higher, than for previous projects.

The largest investments for recultivation are in Vidusaugava region, but they result very moderate in investments per ha, as this region has the biggest area of land to be recultivated. Second largest investments are in Maliena region, they result to be also highest in investments per ha. This is mainly explained, that despite the small number of hectares, the dumpsites require more woks, as there are a lot of very small dumpsites, which have been transported to other bigger, in order to make them more compact and this is a rather costly measure [7].

Landfill investments per ha result to be the highest in Zemgale region. It is explained due to the fact, that there are 2 landfills, i.e. costs double. All this is clearly seen in the Figure 3.

III. Effectiveness of Regional Approach, Evaluated by Development of the Amount of Waste Generated and Change in Number of Inhabitants

There exist two tendencies of waste generation in Latvia. The first tendency states, that growth in economy leads to growth of waste generation and another tendency states, that the more ecologically and waste concerned the State is, the less waste is being disposed in the landfills due to the implementation of re-use, recycling and waste prevention. In the time of waste management inventory, there was a lot of inappropriate data on waste generation and disposal due to different accounting methods waste in volume. Some dumpsites accounted it by geometrical vehicle body volume, not taking into consideration the compression rate (the compression rate in waste collection truck varies from 1,5 till 5). This all led to errors in forecasting of generated waste amounts, used in preliminary plans (2000-2006). Only with the construction of new landfills a new accounting system of waste disposed in tons was introduced.

In the Table 4 the Author has already summarized real situation with waste disposal in the newly constructed landfill sites, with the data obtained by the Author during the summarizing survey performed for LASUA (Latvian Association of Waste Management Companies).

The Table 4 shows, that for example, in the regions of Austrumlatgale and Dienvidlatgale the amount of waste increased in the reporting period. This is explained due to the fact, that the last dumpsites have been recultivated in 2009. There is an increase in Maliena and Zemgale regions as the landfill started its operation not from the beginning of 2008, but from February and August respectively.

TABLE 4
WASTE DISPOSED IN THE NEW LANDFILLS, TONS

Region	Landfill	2004	2005	2006	2007	2008	2009
Austrumlatgale	Krišvnieki	-	-	-	17500	25 280	25800
Dienvidlatgale	Demene	-	-	-	18900	39 000	42000
Maliena	Kaudzītes	-	-	-	-	8 533	9 683
Ventspils	Pentuļi	6 700	14 079	18 194	22 293	22 481	22 303
Liepāja	Ķīvītes	8 600	61 100	61 700	70 350	56 850	55670
Rīga	Getliņi	-	420181	415650	412064	360246	227222
Piejūra	Janvāri	-	-	-	-	-	28300
Zemgale	Brakšķi	-	-	-	-	8700	13000
Zemgale	Grantiņi	-	-	-	-	9800	14500
Ziemeļvidzeme	Daibe	-	45 000	55 000	67 000	60 000	42 000

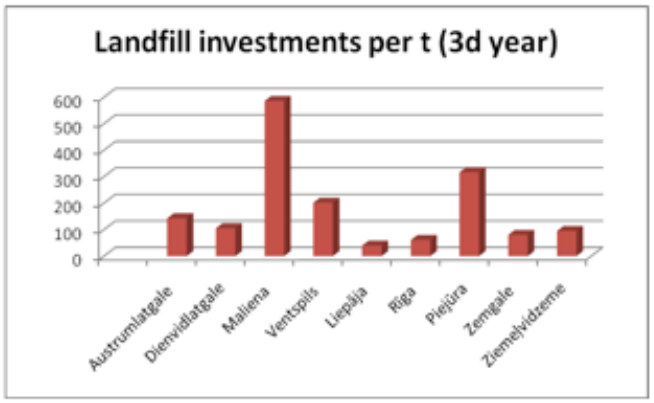

Fig. 4. Landfill investments per ton in the 3[d] year of operation

There is a decrease of waste disposed in other regions, due two reasons – economic downturn and development of sorted waste collection. The most dramatic decrease in waste amount disposed is noted in Riga region, according to the evaluation of "Getlini EKO" Ltd., the decrease is mainly due to the economic downturn and this region is the most affected due to the number of inhabitants and their economic activities.

The decrease of waste disposed is planned to grow, as the rates per ton of waste are considerably low (as many European countries have the rate at about 50 EUR/ton) and as the sorted waste collection is being implemented along with one very strong motivator – Natural Resources Tax, which has grown from 0,25 Ls before 2009 until 5 Ls from 2011 and 7 Ls from 2012 for ton of disposed household waste [8].

The Author has constructed Figure 4 in order to show the cost-effectiveness of landfill investments per ton of disposed waste. The data in the figure is used for each landfill`s 3r[d] operation year and it clearly shows, that the most cost-effective region in these terms has been Liepaja and the least cost-effective: Maliena and Piejura. It is considered, that a region is cost-effective, when there are less investments per ton, which also leads to a conclusion, that the more waste is disposed, the less the investments will be and, taking into consideration, that according to the EU directive, the waste amount disposed should decrease each year, it may be concluded, that in order to keep the regions cost-effective, they have to be amalgamated.

After analysing the plans and forecasts, stated in the Regional plans, the Author has revealed discrepancy of waste amount projections and real situation. All regional plans had a forecast of constant GDP growth of 6,5% until 2010 and with this waste amount was forecasted to grow for 1/3 of GDP growth rate [9]. After analysing the data, obtained from the survey, the Author has come to a conclusion, that the plans, when they were revised, did not take into consideration the updated economic situation.

Table 5 shows that some regions generate smaller waste amounts in comparison with others and it could be logical to unite them with bigger regions. For example, Maliena region could be easily united with Vidusdaugava region, which would result in decrease of landfill investments. This is also logical, as Maliena has fewer inhabitants (as Ventspils and Liepaja were united with Viduskurzeme region) and it also has smallest waste per capita ratio and highest landfill investment per t of disposed waste. The situation in Riga region is explained with the economic crisis and biggest decrease of number of inhabitants from all the regions (for 81 344 in the time period from 2000 until 2009) and increase of sorted waste collection, which leads to 15-20% decrease of waste disposed.

In the Table 6 the Author has provided a summary of obtained data from the survey. It shows the disposal rates per ton of waste, used in 2010. The calculation of disposal rate is performed by each region, based on Methodology set by the Law "On Regulators of Public Utilities".

TABLE 5
GDP AND WASTE GENERATION 2003-2009, TONS

Region	2003	2004	2005	2006	2007	2008	2009
GDP	7.2	8.7	10.6	12.2	10	-4.2	-18
Austrumlatgale	22 700	34 200	32 500	30 800	29 570	25 280	25 280
Dienvidlatgale	47600	53 400	49 800	47 600	45 700	39 000	42 000
Maliena	10 798	13 800	15 700	16 200	12 300	12 000	9 683
Ventspils	20 061	24 700	28 793	33 302	22 293	22 481	22 303
Liepāja	48 700	59 800	61 100	61 700	70 350	56 850	55 670
Rīga	588 788	490 520	420 181	415 650	412 064	360 246	227 222
Piejūra	24 279	24 500	29 800	30 350	30 100	27 750	28 300
Zemgale	23 607	25 300	28 900	33 600	36 207	28 900	27 500
Ziemeļvidzeme	29 570	38 500	45 000	55 000	67 000	60 000	42 000
Vidusdaugava	18 110	18 350	18 900	19 370	19 139	23 700	21 800
Viduskurzeme	14 703	-	-	-	-	-	-

TABLE 6
DISPOSAL RATES PER REGION

Region	Landfill	In operation since	Disposal rate per ton, EUR w/o VAT
Austrumlatgale	"Križevnieki"	2007	27.75
Dienvidlatgale	"Demene"	2007	26.54
Maliena	"Kaudzītes"	2008	28.23
Ventspils	"Pentuļi"	2004	23.85
Liepāja	"Ķīvītes"	2004	24.57
Rīga	"Getliņi"	2005	20.84
Piejūra	"Janvāri"	2009	25.00
Zemgale	"Brakšķi", "Grantiņi"	2008	17.86
Ziemeļvidzeme	"Daibe"	2005	27.45
Vidusdaugava	Landfill is in construction		

The rate has a tendency to increase, as, with the implementation of EU requirements on sorted waste collection, re-use and recycle, less waste amount will be disposed, i.e. the rates will increase in order to recompense the operating costs. The increase of disposal rate may create obstacles for the inhabitants to pay such high fees and may lead to nascence of new illegal dumpsites and loss of control over volumes of de facto generated and disposed waste. This will serve as a challenge for regions, either to increase the rate or to transform the landfill sites into technological parks.

IV. Conclusions

Taking into consideration the analysis and calculations performed in the II part of the present paper, the author has come to the following conclusions:

- the region with lowest amount of overall investments per capita is **Dienvidlatgale**,
- the region with lowest amount of recultivation investments per ha is **Austrumlatgale** along with **Dienvidlatgale** and
- the region with lowest amount of investments for landfill is **Liepaja**.

and:

- the region with greatest amount of overall investments per capita is **Piejura, followed by Vidusdaugava**,
- the region with the greatest amount of recultivation investments per ha is **Ziemelvidzeme** and
- the region with greatest amount of investments for landfill is **Zemgale**.

As new planning period is upcoming, for 2014-2020 it is essential to avoid the abovementioned drawbacks and to make very precise forecasts, taking into consideration the EU requirements on waste minimization (sorting, re-use, recycling), economic ratios and stable inhabitant decrease tendency.

The upcoming investments should be evaluated not for all 10 regions, but the amalgamation of regions should be taken into consideration and the financing should be directed to the effective regions.

When evaluating such factors as landfill investment per ton of disposed waste, waste per capita and GDP, four main conclusions have been made:

1) The regional waste management plans contained a significant mistake – forecast of constant GDP and waste generation amount, interconnected with it (as
2) the plans were reviewed in 2005-2008 (depending on the region)), the developing institutions had to make corrections, according to real situation.
3) When planning the regions, waste generation tendency was 3% yearly growth rate, but. the EU resource saving tendency (decrease of disposed waste and increase of resources brought into reuse) was not taken into account.
4) Cost-ineffective region has been revealed – Maliena region, which, according to all ratios had to be united with nearest region – Vidusdaugava. The regions have to be amalgamated. It is recommended to transform smaller landfills into *technological parks*, where waste preliminary treatment, sorting, composting and even recycling can be undertaken. This, with considerably lower investments, will not only increase landfill functions but also make it an economically-effective multifunctional complex, which would lead to significant improvements in long-term sustainability.
5) The increase of disposal rate can be evaluated as a threat for illegal dumping, but it can also be evaluated as a challenge, for the regional landfills to be transformed into technological parks.

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Natālija Cudečka-Puriņa. Finanšu investīciju efektivitātes izvērtējums Latvijas reģionu atkritumu apsaimniekošanas poligonos
Zinātniskais raksts sniedz ieskatu Latvijas atkritumu apsaimniekošanas sistēmā no ekonomiskā aspekta. Tajā ir apkopotas finansiālo ieguldījumu aktivitātes no 1995. gada līdz 2010. gadam, ieskaitot. Lielākā daļa investīciju atkritumu apsaimniekošanas jomā (66%) saņemtas no Eiropas Savienības ISPA fonda un no Kohēzijas fonda. Atlikušie 33% bija vietējo pašvaldību finansējums. Ņemot vērā to, ka vairākumam pašvaldību investīciju nodrošināšanai bija jāvēršas pēc kredītiem vai kredītlīnijām, ir īpaši svarīgi izvērtēt izveidotās sistēmas ekonomisko efektivitāti, kas arī atspoguļo, vai izveidotais poligons atmaksāsies un nodrošinās arī naudas plūsmu kredītu atmaksai.
Rakstā autore veic investīciju, kuras bija atvēlētas Latvijas atkritumu apsaimniekošanas reģionu infrastruktūras izveidei, efektivitātes izvērtējumu, īpašu uzmanību veltot tādiem rādītājiem kā: iedzīvotāju skaita izmaiņas, IKP rādītāji, radīto un sanitārajos atkritumu poligonos apglabājamo atkritumu daudzums, investīcijas no Eiropas Savienības fondiem un vietējām pašvaldībām.
Veiktās analīzes rezultātā tika secināts, ka Latvijā uz doto brīdi ne visi izveidotie reģionālie atkritumu poligoni ir vērtējami kā ekonomiski efektīvi.
Viens no svarīgākajiem raksta secinājumiem ir, ka sanitārie atkritumu poligoni reģionos ar nelabvēlīgu demogrāfisko situāciju kļūs ekonomiski neefektīvi, tāpēc reģioni ir jāpalielina, lai saglabātu to rentabilitāti un padarītu tos mazāk pakļautus demogrāfisko vai ekonomisko izmaiņu iedarbībai. Ir īpaši svarīgi laicīgi novērst potenciālo neefektivitāti un nepieļaut tarifa pieaugumu, kas būtiski ietekmēs atkritumu apjomu, kas tiek apglabāts poligonā, jo to ietekmēs gan operatoru, gan iedzīvotāju maksātspēja, turklāt pastāv arī draudi, ka tiks veidotas nesankcionētas atkritumu izgāztuves.

Наталия Цудечка-Пуриня. Оценка эффективности инвестиций в отходное хозяйство регионов Латвии
Научная статья описывает систему обращения с отходами в Латвии с экономической точки зрения. Статья обобщила мероприятия по финансовым вложениям в отрасль в период с 1995 по 2010 год включительно. Большая часть инвестиций в отрасль обращения с отходами (66%) была получена от Европейского Союза – фонда ИСПА и фонда Кохезии. Оставшиеся 33% финансировали самоуправления. Принимая во внимание, что большинству самоуправлений, для обеспечения финансирования, было необходимо обратиться к кредитам или кредитным линиям, особенно важно оценить эффективность созданной системы, что покажет, может ли полигон себя окупать и выплачивать кредит.
Автор статьи проводит оценку эффективности инвестиций, направленных на создание инфраструктуры обращения с отходами в Латвии, особое внимание уделяя таким показателям, как демографические изменения населения по регионам, показатели ВВП, объем образуемых и подлежащих захоронению на санитарных полигонах отходов, инвестиции фондов Европейского Союза и местных самоуправлений.
Анализ системы показал, что не все полигоны, созданные в Латвии, на данный момент являются экономически эффективными.
Один из важнейших выводов статьи заключается в том, что санитарные полигоны для отходов, расположенные в регионах с неблагоприятной демографической ситуацией, станут экономически неэффективными, поэтому необходимо укрупнять регионы, чтобы сохранить их рентабельность и сделать их менее подверженными влиянию демографических или экономических изменений. Особенно важно заблаговременно предупредить потенциальную неэффективность и не допустить роста тарифа, что существенно повлияет на объем отходов, подлежащих захоранению, поскольку затронет платежеспособность как операторов, так и населения и из этого так же существует возможность создания несанкционированных свалок.