

Paper 53. Towards Sustainable Waste Management in the Baltic Sea Region Countries: the contribution of universities

Walter Leal Filho* (a), Jolita Kruopiene (b), Harri Moora (c), Åsa Stenmarck (d)

(* Corresponding author

a) Research and Transfer Centre “Applications of Life Sciences”, Hamburg University of Applied Sciences Faculty of Life Sciences, Lohbrügger Kirchstraße 65, 21033 Hamburg, Germany

b) Kaunas University of Technology, Institute of Environmental Engineering, K. Donelaičio g. 20, 44239 Kaunas, Lithuania

c) Stockholm Environment Institute Tallinn Centre, Lai 34, 10133 Tallinn, Estonia

d) IVL Swedish Environmental Research Institute, Box 210 60, 100 31 Stockholm, Sweden

Abstract

The purpose of this paper is to analyse how universities in the Baltic Sea region contribute to attempts to achieve a sustainable waste management. A regional project “RECO Baltic 21-Tech” (partly funded by Baltic Sea Region Programme 2007-2013) serves as an example of mutual benefits: universities via professional research and education contribute to a sustainable waste management in the region, at the same time gaining interesting topics for research, possibilities for capacity building and curricula enrichment for students. It is pointed out that at present, the region possesses great disparities regarding the ways it handles and processes waste, meaning there are some countries which recover most of the waste they produce, whilst a number of other nations are lagging behind. Such disparity needs to be addressed in order to accommodate a more sustainable solution to waste management issues, and Universities together with other research institutions find their prominent role here. The important feature of the analysed case, presented in the paper, is inclusion of regional aspect into education and research on waste management.

Key-words

Baltic Sea region, sustainable waste management, RECO Baltic 21-Tech, Universities

Introduction

Science is aimed at generating true knowledge, engineering is about changing the world. Therefore, the world of technology is far more directed towards changing our society than the sciences and the arts are. It is therefore especially important that engineers are taught to deal with the problems of society (Staniškis and Stasiškienė, 2006). Waste treatment and management is one of the crucial problems of modern society. The increasing economic prosperity in the European Union is accompanied with higher consumption levels and consequently – a growing amount of post-consumer waste. Today, the EU generates about 275 million tonnes of household waste annually, which is on average 450-500 kg/ capita. Improved waste management and waste prevention is therefore perceived as an important step towards sustainable development, and engineers have to be taught to deal with this issue.

Waste management in the Baltic Sea Region

The Baltic Sea region includes ten countries within the drainage area of the Baltic Sea, which have significant disparities between the levels of municipal waste management. Looking at the main characteristics of municipal waste management sectors, the countries can be clustered into three groups. The region can be schematically seen in Fig. 1.



Fig. 1. The Baltic Sea Region

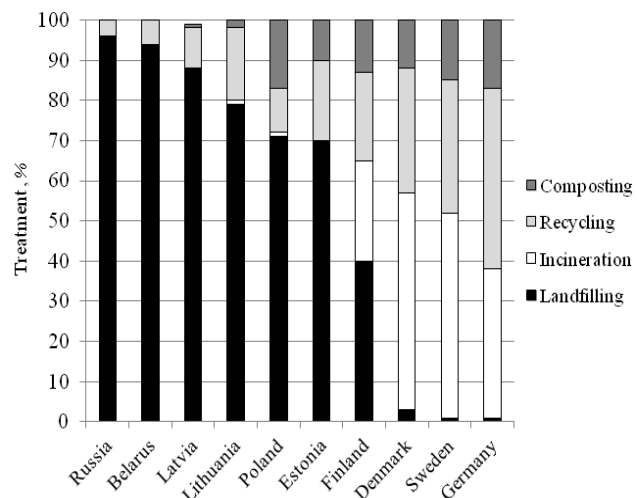


Fig. 2. Municipal waste treatment in BSR countries, 2011 (Eurostat, 2013).

The first group of countries, i.e. Sweden, Finland, Denmark and Germany, are “old” EU Member States with high gross domestic product (GDP) and established institutional set-ups, have well-developed waste management infrastructures with very little landfilling (less than 5% of waste treated in Germany, Denmark and Sweden, ~ 40% in Finland), as well as high rates of separate waste collection and recycling (see Fig. 2). Compared to other countries in the region, these countries also generate a high volume of municipal waste. Denmark, with 781 kg per person, had the highest amount of waste generated in 2011, followed by Germany, Finland and Sweden with values between 600 and 450 kg per person (Eurostat, 2013). This first group of countries has a good level of organisation and fairly adequate financing schemes from mostly national (public or private) sources.

Another group – Estonia, Latvia, Lithuania and Poland – are new EU members, with GDP rates typically half of the EU average. The amount of municipal waste generated is much less than in the first group of countries (reported as below 450 kg/person/year in 2011 by Eurostat, 2013). Municipal waste infrastructures and institutions are currently under development. While municipal waste recycling rates are steadily increasing, the majority of waste is still landfilled and the quality of waste separation and recycling efficiency remains generally low (see Fig. 2). The countries are also experiencing shortcomings in the public financing of waste management, whereas the EU structural funds are still playing a significant role.

The two groups both have to adhere to the EU waste legislation, although the eastern neighbours still have somewhat different targets and implementation schedules. However, this “two-speed Europe” approach is set to be phased out, implying significant challenges in terms of infrastructure modernisation, optimisation of institutional and legal set-ups, and securing adequate sustainable financing less dependent on EU cohesion funds.

The non-EU countries of Russia and Belarus form another group in the BSR with even less developed waste management sectors and weak institutional and administrative set-ups in terms of effectiveness. Most of the municipal waste is landfilled, and only very few landfilling sites are comparable to those acceptable by EU standards. Separate collection and recycling levels are gradually increasing, but they are still very low (see Fig. 2). The situation with financing is even more critical, as they are not eligible for the majority of EU financing. The state plays a dominant role in setting municipal budgets and regulating tariffs for local public services (incl. waste management). Whilst the municipalities are weak, they are still legally responsible for organising waste management similar to the other countries in the BSR. The involvement of the private sector is emerging but is very marginal and not yet transparent.

Research and education on waste management at Universities in the Baltic Sea region

Having in mind all the above described situation of waste management in the region, the role of Universities, as research and education institutions, seems to have a vital role on the way towards a sustainable waste management. Countries on the Eastern side of the Baltic Sea need quicker developments in shifting waste management up the waste hierarchy. Of course, each country has to find its own way, but at the same time it is possible to learn much from those who are ahead in the development. Research carried out by University staff can contribute to searching for the best waste management scenario for the particular country, as well as for a proper overtake of experience accumulated in the other countries. For countries on the Western side, the way towards a sustainable waste management means a further improvement of their already mature systems. Thus, they need new ideas, innovations, new targets – everything that can be offered by qualified researchers from Universities and other research institutions. Educating future specialists who will take care for waste management in the near future and who will be taking decisions, is another possibility of Universities to play their role on a way towards a sustainable waste management.

Universities in the Baltic Sea region are involved in research on various waste management topics. The most active in this field are German, Danish, Swedish, also Finish Universities, what correlates with waste management situation in the region. The topics of research cover various waste treatment technologies, waste generation, prevention, recycling, as well as various waste management strategies (e.g. Helftewes et al., 2012; Damgaard et al., 2013; Bersntad et al., 2013; Teerioja et al., 2012). Fewer researchers from fewer universities on the Eastern side of the Baltic Sea are doing research in the field of waste management and waste treatment technologies, but still there are some (e.g. Den Boer et al., 2012; Rimaitytė et al., 2010; Dace and Blumberga, 2012; Moora et al., 2006).

Courses on waste management and treatment are included into curricula of nearly all universities having study programmes related to the environment (programmes Environmental Engineering, Environmental Technology, Environmental Management, Environmental Sciences or similar), in spite if it is a university on west or east side of the Sea. Some universities have M.Sc. programmes that are concentrating namely on waste management (e.g. at Luleå University of Technology). The big benefit for courses is when they are being based on ongoing research at the University. Internationalization is another benefit both to research and to study courses, and requires participation of researchers and professors in bi-lateral or multilateral projects and exchange projects.

Regional projects on waste management. RECO Baltic 21 - Tech

The Baltic Sea Region (BSR) Programme 2007-2013, or INTERREG IV B Baltic Sea Region, was designed under the European Community's territorial cooperation objective. The strategic objective of the BSR Programme is to strengthen the development towards a sustainable, competitive and territorially integrated Baltic Sea region by connecting potentials over the borders.

RECO Baltic 21-Tech (RB21T) project, one of the BSR Programme 2007-2013 co-financed projects, is acknowledged as both a EUSBSR flagship (i.e. a project is mentioned in the Action Plan of EU Strategy for the Baltic Sea Region) and a CBSS Lighthouse project (i.e. a project is officially registered by the Council of Baltic Sea States due to its far-reaching regional impact and interest). It encompasses universities, research centres and companies, which work hand in hand in the search for solutions for the problems associated with waste management, which is a matter of great concern to Baltic Sea region countries, where significant national disparities are seen. The directly participating universities are Hamburg University of Applied Science (HAW), Gdansk University of Technology (GUT) and Kaunas University of Technology (KTU). Lund University is an associated partner in RB21T project. University of Latvia, Tallinn University of Technology and Belorussian State University have indirect links to the project via staff who participate in RB21T activities as representatives of other research institutions or associations, but at the same time have tasks at these universities as well. This way, universities from all countries participating in RB21T are included. The other institutions, taking part in the project, are research institutions IVL Swedish Environmental Research Institute (Sweden) and SEI-Tallinn (Estonia), as well as a number of associations, municipalities and business development organisations.

The current project has a predecessor, a project on Regional Cooperation in Waste Management (RECO), also co-financed by ERDF funds and carried out during 2005-2008. Thus, RB21T relies on a solid and devoted partnership and continues working on fostering sustainable waste management (WM) in the BSR. The duration of Reco Baltic 21-Tech is from 2011 till the end of 2013. Its overall objective is to improve the local and regional capacity to apply the process of implementing waste management that catalyse the execution of the EU Directives and supports the region to climb in the waste hierarchy.

Mutual benefits: impact on project results and achievements for universities

Education for sustainable development might be understood as the integration of sustainable development in the education, research and operations of a university (Staniškis, 2013). Thus, university has four roles in society: it acts as an educational institution and shall deliver sustainably educated professionals; it is a research institution and delivers the results of research to society; it has, as all organisations, all kinds of operational interactions with the outside world, like procurement, use of materials, energy and water, the production of waste, etc.; and finally it has a direct interaction with society, e.g. by participation in environmental or cultural events, etc.

In order to achieve its aims and to help the Baltic Sea region climb in the waste hierarchy and move towards a more sustainable waste management, RECO Baltic 21-Tech included a variety of activities. Participation in these activities enabled universities to meet most of the above mentioned roles.

Capacity building

As stated by (Agamuthu and Hansen, 2007), there are many opportunities for interaction between universities and other institutions (business, municipality administrators, governments and NGOs) to build knowledge and interculturally stable societies. Capacity building in higher education and research is one way of increasing capacity for fair global, regional and sustainable

development. A number of universities in the Baltic Sea region have experiences working across cultures and co-operating with distant regions, like Danish universities with universities in Thailand, Malaysia and south Africa (Agamuthu and Hansen, 2007; Wangel et.al, 2005).

RB21T included study visits among its activities, aimed at building capacity of various stakeholders by sharing expertise and experience, by showing good practise examples within the Baltic Sea region. Representatives of the participating Universities have been among those participating in the study visits to a newly constructed MBT plant in Estonia, plastic recycling company in Lithuania, anaerobic digestion plant for food waste in Hamburg, municipal waste management centre in Sweden, etc. Some of the study visits have been combined with the regional waste management conferences, organised by RB21T on sustainable waste management issue in the Baltic Sea region. The conferences consisted of presentations by invited speakers and of discussions, and attracted numerous participants from authorities, waste management companies, academic institutions from the whole region.

RB21T initiative, the so-called Baltic Waste Management Council (BWMC), is a continuation of the previous RECO project tradition. BWMC meeting takes place at least once a year. This way the project aims to facilitate for decision makers at local and regional levels to optimize their waste management investments, to share problems and achievements. BWMC was used as a reference group when creating Joint Baltic Sea Region Strategy for Municipal Waste Management – one of the major project outcomes. In many instances project conferences, study visits, BWMC meetings were taking place in connection with each other, enabling a multi-level stakeholder dialogue.

Database on waste-management related information has been created during the project. Its scope are countries around the Baltic Sea, and the database contains information on companies and organizations, which are providing waste management technologies, or dealing with waste management themselves, in the Baltic Sea region. Another important aspect is inclusion of reference objects, which are pilot projects that have been undertaken during the RB21T. There have already been some study visits to these reference objects, e.g. by Belorussian delegation including practitioners and academic people.

Universities' capacity building was not limited to internal project activities, but researchers enjoyed also a possibility to join to the study tour organised by ISWA, to take part in a number of international conferences, exhibitions and other events.

Research

In total, 18 pilot projects related to biodegradable waste management, recycling of secondary raw materials and biogas from landfills have been carried out during the project in Estonia, Latvia, Lithuania and Belarus, with participation of universities from these countries. Depending on the type and needs of the particular pilot project, they included research activities, feasibility studies, environment impact assessment, business plans and other, i.e. considered technological, environmental, economical and social dimensions. The aim was to unlock investments of €20m into waste management and treatment facilities. Furthermore, developing concrete waste management or treatment pilot projects enabled the identification of the main challenges, which are being faced by municipal and private project developers.

Researchers and lecturers sometimes interpret sustainable development too narrow, too specifically concentrating on only one of the three dimensions of sustainable development, mostly on the environmental aspect in the case of technical disciplines (Staniškis, 2013). RB21T has a few important outcomes, which show the relevance of all these aspects when striving for a sustainable waste management. These important outcomes are:

- Joint Baltic Sea Region Strategy for Municipal Waste Management;
The region was lacking a common vision and a shared strategy for how to address the problems of sustainable municipal waste management and take best advantage of international collaboration in using countries' experiences, best practices and sharing

capacities and infrastructures. In order to facilitate the higher order waste management hierarchy solutions a common vision and a joint strategy for the Baltic Sea region has been developed. It is targeted towards decision-makers on an EU, national and local level.

- Baltic waste investment concept;

It aims to assist all stakeholders in making the required sustainable investments into waste management projects.

Life Cycle Assessment (LCA) has been used to support decision making in old EU member states of the Baltic Sea region for over a decade. Technical University of Denmark (DTU) and IVL Swedish Environmental Research Institute are the two leaders in the region, having developed specialised software tools EASEWASTE and WAMPS, respectively, for waste management planning based on LCA. It is now being gradually introduced into the decision-making processes in the new member states as well (Moora et al., 2006; Miliūtė and Staniškis, 2010). Tallinn University of Technology and Kaunas University of Technology have cooperated in the development and use of WAMPS already during the previous RECO project, resulting in a couple of Ph.D. thesis produced (Miliūtė, 2009; and Moora, 2009). Development and use of WAMPS continued during RB21T. It has been applied in a few pilot projects, namely in development of regional waste management plan and development of mechanical biological treatment of municipal waste in the Alytus region (Lithuania), in development of the biowaste composting system in the city of Narva (Estonia), and also in development of a pretreatment method for biowaste in Piejura waste management region (Latvia). For the latter case, one more university, i.e. University of Latvia and its Ph.D. student, has been involved.

Education

Although WAMPS is primarily to be used as a tool and as a support for decision in the planning process for designing the most suitable systems from an environmental point of view for waste management in a certain region with its specific conditions, it is also a great tool to be used by students in their learning process. So in addition to being used by doctoral and M.Sc. students for their research and preparation of thesis during RECO, WAMPS has enriched the contents of the study course “Integrated waste management” in M.Sc. programme in Environmental Management and Cleaner Production at KTU, Lithuania.

Students benefited both via direct participation in the project events (conferences, study tours) and via the lecturers, who can share with students their new knowledge and experience broadened to the regional scale, adding the regional waste management perspective to the contents of courses on waste management. RB21T provided students from the region with the opportunity to conduct problem-oriented projects based on real-world cases. Examples of such projects are analysis of waste management situation in countries of the region, use of decision making tools in the region, impact of waste management on territorial development, RDF production possibilities from sewage sludge.

One more output of RB21T is development of internet data base, administered by GUT, with information clustered into various waste management related themes. Information is organised in such a way, that it can be used to prepare various waste related trainings for different stakeholders, or lectures for students.

RB21T experience inspired organisation of the summer course on Sustainability and Waste Management in the Baltic “Making Waste Work”. It was organised in cooperation of the Baltic University Programme (it is a network of about 225 universities and other institutes of higher learning throughout the Baltic Sea region) with RB21T at HAW. The course offered a state-of-the art overview of matters related to sustainable development and waste management provided by international experts from the Baltic Sea region. Students from various subjects currently registered

at universities across the Baltic Sea attended the Summer Course. It got booked well before the registration deadline, showing the relevance of the topic and of such form of education.

Other remarks

Regarding operational interactions of organisations with outside world, RB21T was focusing on procurement issues, this way contributing to capacity building of institutions dealing with waste management. The project was not directly dealing with operations of universities. Nevertheless, as management of biodegradable waste and waste recycling were among topics of the pilot projects, they contributed with ideas to the development of paper waste management and green waste management at KTU. A couple of M.Sc. thesis have been prepared on these topics, and paper waste management has already been put into practise (Adomavičiūtė, et al., 2012)

Conclusions

Universities, as research and education institutions, have a significant role on the way towards sustainability, including a sustainable waste management. It is demonstrated that universities' participation in regional co-operation projects can bring mutual benefits to both society via the project results, and to universities themselves. For the Baltic Sea region, where significant disparities among the countries exist, universities have resources to contribute to the exchange of experience between the countries and to suggest ideas for further development towards sustainability. The participating universities themselves have improved their capacities, enriched the contents of courses on waste management (use of WAMPS, view on waste management issues from the regional perspective, etc.), enriched education with summer courses, offered students real-life topics for their projects, and interesting topics for research.

The hope is that the experiences from the RECO Baltic 21 Tech project as a whole, and the experiences gathered in getting universities to work together with other organisations, will serve as an inspiration to other similar initiatives across the regions.

References

Adomavičiūtė, T., Kruopienė, J., Varžinskas, V., Gorauskienė, I. (2012) Waste sorting habits by the community of Kaunas University of Technology. *Environmental research, engineering and management*, No. 4 (62), pp. 57-67.

Agamuthu, P., Hansen, J.A. (2007), Universities in capacity building in sustainable development: focus on solid waste management and technology. *Waste Management and Research*, Vol. 25 No. 3, pp.241-246.

Bernstad, A., Malmquist, L., Truedsson, C., la Cour Jansen J. (2013), Need for improvements in physical pretreatment of source-separated household food waste. *Waste management*, Vol. 33 No.3, pp. 746–754.

Dace, E. and Blumberga, D. (2012) An assessment of the potential of refuse-derived fuel in Latvia. *Management of Environmental Quality: An International Journal*, Vol. 23 No.5, pp. 503-516.

Damgaard, A., Manfredi, S., Merrild, H., Stensøe, S., Christensen, T.H. (2011), LCA and economic evaluation of landfill leachate and gas technologies. *Waste Management*, Vol. 31 No.7, pp. 1532-1541.

Den Boer, E., Den Boer, J., Jaroszyńska, J. and Szpadt R. (2012), Monitoring of municipal waste generated in the City of Warsaw. *Waste Management and Research*, Vol. 30 No.8, pp. 772–778.

Eurostat (2013) Eurostat newsrelease 33/2013 – 4 March 2013, available at: http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/8-04032013-BP/EN/8-04032013-BP-EN.PDF (accessed 7 May 2013).

Helftewes M., Flamme S., and Nelles M. (2012), Greenhouse gas emissions of different waste treatment options for sector-specific commercial and industrial waste in Germany. *Waste Management and Research*, Vol. 30 No. 4, pp. 421–431.

Moora, H.; Stenmarck, Å., Sundqvist, J-O (2006). Use of Life Cycle Assessment as decision-support tool in waste management planning – optimal waste management scenarios for the Baltic States. *Environmental Engineering and Management Journal*, Vol. 5(3), pp. 445–455.

Moora, H. (2009) Life cycle assessment as a decision support tool for system optimisation – the case of waste management in Estonia. Ph.D. thesis. Tallinn University of Technology. Tallinn, TUT press. p. 174.

Miliūtė, J. (2009) Integrated municipal waste management system decision support model. Ph.D. thesis. Kaunas University of Technology. Kaunas, Technologija, p. 168.

Miliūtė, J.; Staniškis, J. (2010) Application of life-cycle assessment in optimisation of municipal waste management systems: the case of Lithuania. *Waste Management and Research*, 28(4), pp. 298–308.

Rimaitytė, I., Denafas, G., Martuzevičius, D., Kavaliauskas, A. (2010), Energy and environmental indicators of municipal solid waste incineration: toward selection of an optimal waste management system. *Polish Journal of Environmental Studies*, Vol. 19 No.5, pp. 989-997.

Staniškis, J.K. (2013), Engineering education for sustainable industries. *Environmental research, engineering and management*, No. 1(63), pp. 3-4.

Staniškis, J.K., Stasiškienė, Ž. (2006) An integrated approach to environmental education and research: a case study. *Clean Technologies and Environmental Policy*, Vol.8, pp. 49-58.

Teerioja, N., Moliis, K., Kuvaja, E., Ollikainen, M., Punkkinen, H., Merta E. (2012), Pneumatic vs. door-to-door waste collection systems in existing urban areas: a comparison of economic performance. *Waste Management*, Vol. 32 No.10, pp. 1782-1791.

Wangel, A., Steardahl, J., Pedersen, K.B., Abdullah, M. (2005) Learning by knowledge networking across cultures: the experience of joint courses in environmental studies for Malaysian and Danish engineering and science students. *The Journal of Transdisciplinary Environmental Studies*, Vol.4, No.1, pp. 4-9.