

Considerations on Environmental Engineering Education for Sustainable Development in Oltenia Region

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Abstract: The paper present general issues and current state concerning the environment in Romania and the Sectorial Operational Programme for Environment, an important strategically part of the National Development Plan and National Strategic Reference Framework, which takes into consideration the European Union's supporting principles and practices. There are presented collaborative and interdisciplinary university educational and research activities to assist government agencies, local and regional communities and industrial companies for better meet of the continuous changing needs of the environmental engineering education for a regional sustainable development.

Key-Words: - environmental engineering education, industrial / agricultural activity, sustainable development

1 General Issues Concerning the Environment in Romania

Romania is the thirteenth country in Europe as size (238,391 km² area) and according to statistical data for 2006, has a population of about 20.6 million inhabitants.

Placed in the Europe interference area of Carpathians-Danube and Danube-Black Sea ecosystems, Romania has diverse and balanced natural and landscape heritage.

Natural resources represent an essential part of Romania's richness and the exploitation of these resources, both renewable and non-renewable raw material, determines the social and economic development of the country, environmental status and living conditions of the population. In order to contribute to the quality of life in Romania, natural resources need to be exploited in a sustainable development manner. This mission is to find ways to increase the total wealth at the same time with prudently use of natural resources, so as the renewable sources to be maintained and nonrenewable sources to be used taking into account the needs of future generation.[5]

Current state of the environment

Water resources. Romania is endowed with all types of fresh water resources (rivers, natural and artificial lakes, the Danube River and the ground waters). The largest resource of fresh water comes from the Danube and other rivers. The usable water resource is 2,660 m³/inhabitant/year, compared with the European average of 4,000 m³/inhabitant/year.[6]

This difference is largely due to the reserves contamination in the past, linked to domestic and economical activities with no consideration of environmental protection.

Wastewaters. The volume of wastewaters discharged in 2006 was 3,334 million m³, of which almost 60% needed to be treated. Out of the total volume of wastewater needed to be treated, approximately 30% have been sufficiently treated, while other almost 70% of wastewater was discharged into the natural receivers, especially rivers, untreated or insufficiently treated.

This is mainly due to the lack or insufficient treatment facilities across the country.

The annual volume of *drinking water* distributed is around 1,350 million m³, out of which 811 million m³ is for domestic usage. In the last 10 years, the total water volume distributed in the network has decreased; this is mainly due to the metering and to the decline in industrial activity.[6]

Public drinking water supply network. Only 65% of the population benefit from mains drinking water supply and indoor plumbing.

This includes 98% of urban population and 33% of the rural population, lower ratios in comparison with those in Europe (96% -100% of the population connected to public water supply network in urban areas and 87% in rural areas. More than 86% of the resident population of 256 urban localities (about 11.5 million inhabitants) is supplied with drinking water through the public networks. Due to long term under-investments in the water supply systems, in

55 urban localities (21.5%), the population is connected in 100% ratio to the public water supply system.[6]

Water pollution is one of Romania's largest environmental issues. Water pollution from household, industrial and agricultural sources has a negative impact on fish breeding, irrigation, and drinking water supplies. Poor water quality arises mainly from poor controls over industrial effluents and discharges and from inadequate wastewater infrastructure. Collections of water effluent charges are still modest in Romania but they have reduced pollution over the recent years.[6]

Flood risk. There have been some catastrophic floods in recent years resulting in loss of human and animal lives and drastic alterations to the landscape. Their frequency, and their proportion, appears to be on the increase. It is supposed that this flooding is due to climate change, modification of riverbeds and unauthorized land clearings. The most vulnerable areas are the Crisuri, Someș, Mureș, Tarnave, Timiș, Olt, and Argeș river basins.

Soil quality. Preliminary studies on soils pollution in Romania indicate around 900,000 ha affected by different types of pollutants on certain levels of pollution. The most notable factors that lead to the pollution/degradation of soils are: mining and quarry activities; ponds, mining dumps, non-complying landfills; inorganic residues and waste (minerals, inorganic material, metals, salts, acids, alkalis); salted waters from petroleum extraction, petroleum pollution; air-transported substances (hydrocarbons, ammonia, sulphur dioxide, chlorides, fluorides, nitrogen oxides, lead compounds). Although recently some industrial plants have been closed and others have reduced their activity soil pollution maintains high in the affected areas.

Waste management represents one of the most serious environmental protection problems in Romania. Romanian statistics distinguish between two categories of waste: municipal waste and waste similar to it, and production waste. Landfilling is the main method for municipal waste disposal. The municipal landfill inventory records 251 registered sites, out of which only 18 landfills will be in EU regulations conformity by the end of 2006. The remaining landfills that do not conform to EU regulations are scheduled to cease to operate, gradually by 2017. There are no organized waste management services in most of the rural areas, this leading to a high number of unauthorized landfills highly affecting the environment and the population. The waste production remains very high while the separate collection of waste and waste recycling are still slowly improving. The waste related legislation in Romania, now in line with EU acquires, imposed

positive changes over the past years, but many efforts are still needed to meet compliance with the European standards.[6,7]

Climate change and air quality. Romania is expected to be one of the first countries to meet its Kyoto objectives to reduce by 8% greenhouse gases emissions (GHG) from a 1989 baseline. This decrease, particularly in CO₂ emissions, is due to the reduction in burning fossil fuels (CO₂ emissions in 2002 represented 58% of CO₂ emissions in the reference year).[6,7]

Emissions of atmospheric pollutants, originating from fossil-fuelled large combustion plants (LCP) that generate heat and electricity have a significant environmental impact. There are 175 LCP but only 9 comply with Directive EC/80/2001; these plants emit high concentrations of particulates, and nitrogen and sulphur oxides, which cause acid rain and cause a significant health risk, mainly in urban industrial areas. The main origin of Romania's poor urban air quality is low-grade fuel. The thermal energy sector is still relying on low efficiency of solid fuels, on sulphur high-content in heavy fuel and low-income families in towns rely on poor-quality coal for heat. Transport is also an increasing factor in low urban air quality as a large proportion of cars are old and poorly maintained, running on petrol that has the one of the highest lead content among Eastern European countries. This later factor is however decreasing due to changes in the legislation aiming to meet European standards.[6,7]

Biodiversity and nature protection. In Romania, there are 13 National Parks and 13 Natural Parks as well as the "Danube Delta" Biosphere Reservation. The total area they cover is 1.65 million ha, which represents 7% of the total terrestrial country surface. In addition to these reservations there are 935 scientific reserves, monuments of nature and natural reserves with a total estimated at 180,000 ha. Therefore, the coverage of natural protected areas represented almost 8% of the country at the end of 2005, and by the end of 2013, this should reach 15%.

Natural habitats. The country's natural and semi-natural ecosystems cover 47% of its territory. A number of 783 habitat types have been identified in 261 areas covering the whole country. Also, 44 Important Birds Areas were identified covering 3% of the total country area. The high habitat / ecosystems diversity reflects the high level of flora and fauna species diversity. However, many plants and animal species are in danger due to excessive exploitation of the natural resources linked to economic activities in the past; the modification of the landscape is an important indicator for environmental deterioration.

2 National Environment Protection Policy

In Romania, the Sectorial Operational Programme for Environment (SOP ENV) is closely linked to the national objectives of the strategy laid down in the National Development Plan (NDP) and National Strategic Reference Framework (NSRF), which takes into consideration the European Union's supporting principles and practices. It is designed to lay the foundation and be a catalyst for a more competitive economy, a better environment and more balanced regional development.

The SOP continues and builds for the future, on national environment infrastructure development programmes, and takes into consideration the facilities and development projects of the pre-accession assistance programmes (Phare and ISPA).

The SOP is fully based on the goals and priorities of the European Union's environment and infrastructure policies and reflects Romania's international obligations as well as its specific national interests.[6]

The overall objective of SOP is to protect and improve the environment and living standards in Romania.

The aim is to reduce the environment infrastructure gap, both in terms of quantity and quality, which exists between the European Union and Romania.

This should result in more effective and efficient services, while taking fully into account sustainable development and the polluter pays principle.

The programme covers the period of 2007-2013, but its objectives also look forward to Romania's development needs beyond 2013 by laying the foundations for sustainable economic development. It will contribute to Romania meeting its EU obligations to the environment sector, particularly in the less developed regions of the country.

The starting point for SOP ENV is the analysis of the current situation of the environment in Romania. It is followed by the SWOT analysis, on which the development strategy is built.

The SOP also contains a description of the priority axes, key intervention areas and projects identification, as well as the implementation provisions.

The Ministry of Environment and Water Management (MEWM) did the elaboration of the SOP ENV, under the coordination of the Ministry of Public Finance and in collaboration with local,

regional and central authorities and other stakeholders involved in this field.

The implementation of the programme is the responsibility of the Managing Authority for the SOP ENV (MA ENV), is the General Directorate for the Management of Structural Instruments of MEWM. In order to carry out the programme more efficiently, the Regional Environmental Protection Agencies were designated as Intermediate Bodies (IBs) for the SOP ENV.[6]

The SOP ENV is one of the seven operational programmes under Objective "Convergence" for the EU programming period of 2007-2013.

It has been drawn up in correlation with the third Priority of Romania NDP 2007-2013 - "Protection and improvement of environment quality" and the priorities under NSRF - "Develop Basic Infrastructure to European Standards".[5,6]

The SOP contains essential elements for the successful implementation of the NDP and NSRF referring to environmental protection development; its basic objective is to promote sustainable development of the country.

Taking into account the close link between environment and other economic and social sectors, SOP has been developed in correlation with other Sectorial Operational Programmes in order to avoid overlaps and to achieve complementarities between programmes.

The SOP's total budget for the 2007-2013 programming period is approximately 4.900 billion Euros, which represents 23.4% of the financial sources of the NSRF.

Out of this, 3.960 billion Euros is envisaged as community support, more than 940 million Euros comes from the national budget.

The community sources are ensured from the Cohesion Fund and the European Regional Development Fund.

The SOP ENV was developed in line with the *acquis communautaire* laying down the general provisions on Community funds management during 2007-2013.

The areas to be supported through SOP ENV comply with the provisions laid down in Regulations (EC) of the European Parliament and of the Council on the European Regional Development Fund and the Regulations on Cohesion Fund. Romanian and EU regulations, as well as their plans and programme documents were also used for the preparation of the Sectorial Operational Programme for Environment. [5,6]

3 Environment Protection in Oltenia Region

Oltenia Region is situated in south-west of Romania has 29212 km², which represents 12.3% of Romania area. *Oltenia Region* is composed in five counties: *Dolj*-7,414 km²/744,000 inhabitants; *Gorj*-5,602km²/395,000 inhabitants, *Mehedinti*-4,933km²/322,000 inhabitants, *Olt*-5,498km²/508,000 inhabitants, *Vâlcea*-5,765km²/431,000 inhabitants, and its 2 million inhabitants represents 10.3% of Romania population.

In year 2000, in *Oltenia Region* were registered approx. 26,800 enterprises (the figure representing only the enterprises organized as commercial enterprises, not budgetary): 66 mining activity; 2967 manufacturing activity; 59 electrical and thermal energy, gasses and water activities; 19775 en gross and en detail commerce, maintenance activities; 940 hotels and restaurants activities; 681 transport and deposits activities; 57 post and telecommunications activities; 841 services activities; 41 education activities; 217 health and social assistance.

The large enterprises (780) activity concern in manufacturing, construction, transports, mining, energy, gasses and water, and the SME activities is represented by commerce, services and distribution.

An important environment impact is produced by large enterprises activities: the largest Romanian electrotechnical industry company in *Dolj* county, automobile industry in *Dolj* county, cement plant in *Gorj* county, 7 large combustion plants in *Dolj*, *Gorj*, *Mehedinti* and *Valcea* counties, one of the most important sun flower oil company in *Dolj* county, 2 important chemical companies in *Dolj* and *Valcea* counties, the largest Romanian aluminum making company in *Olt* county, the most important European hay-water producer in *Mehedinti* county, e.a

In *Dolj*, *Olt* and *Valcea* counties the agricultural and horticultural domains represent one of the important activities.

The main problems affecting the environment in *Oltenia Region's* counties is caused by soil erosion and the danger of desertification within *Dolj* and *Olt* counties, the soil quality is damaged due to mining activities in *Gorj* and *Mehedinti* counties and chemical substances affect *Dolj* and *Valcea* counties.[6]

The air quality is poor in *Olt* County and there is the danger of landslide in *Valcea* and *Dolj* counties. The precarious conditions of the wastewater-collecting network generate a high level of pollution of the water flows, and the insufficient number of

waste deposits has negative influences on the environment.

Wastewater

The length of the regional water supply network measures approx. 4,000 km (9% of the national network which measures approx. 45,000 km), ranking the last but one place among all development regions. *Oltenia Region* has the least number of localities supplied with water in the whole country.[6]

The length of regional sewerage network is 1,352 km (8.14% from the length of national sewerage network), *Oltenia Region* being the last from this point of view. Also, the *Dolj* county has the smallest number of localities connected to the sewerage network. Wastewater treatment plants are worn out and outdated, the treatment capacity is insufficient for the wastewater flow. Most wastewater treatment plants do not achieve the required quality standards; the wastewater flows insufficiently treated being spilt over the receiving watercourses.[6]

The direct discharge of untreated water due to the absence of the treatment plants represents a major problem.

The causes of inappropriate functioning of the treatment plants refer to their undersize, the wearing out and the inappropriate use.

Waste management

Sanitary services cover 36% of the region's total population; 98.7% of the urban population, respectively 1.25% of the rural population is provided with sanitary services.[6]

In 1999 the biggest industrial waste quantities were recorded in *Valcea* and *Mehedinti* counties. The decantation dust from the Govora Soda Factory causes the dangerous waste, which affects the biggest surface of Romania. It is also important to mention the area affected by the decantation dust of *Doljchim Craiova*.

Another problem is caused by a lack of domestic and animal waste management services in the rural areas; the producers individually transport the waste to storing places.

The collection of the domestic wastes is not made separately and an important part of the reuse potential (paper, glass, metals, plastic) is wasted. As a result, the waste pits generate serious phenomena in the location areas.

The waste water infiltrations in the phreatic and the decay of the underground water, the light materials (paper, polyester, dust) are drifted by wind from the storing places to the cultivated fields or localities and bad odors are caused by the wastes.

The impact generated by the waste produced and improperly stored consists in altering of the quality of environment values (wind-generated ash drifts occur arrears 20-30 yearly, which represent the main negative effects of the slag and ash pits, with consequences upon the perimeter and surrounding areas of the pits).[6]

4 Considerations on Environmental Engineering Education in University of Craiova

The Environment Protection and Sustainable Development Research must represent a link between the University and government, industry, and the non-profit community on a wide range of issues related to environmental management and sustainable development.

The University has to enhance the understanding and adoption of sustainable development principles through education, outreach, research and community involvement, to promote, facilitate and deliver interdisciplinary education; and, through community-based program development and applied research, to work with local and regional communities and government agencies to further sustainable development at a variety of scales.

The University of Craiova, with more than 24,000 students in 17 faculties is representative in academic education in *Oltenia Region*. In the University of Craiova the environmental engineering education is realised in the Faculty of Electomechanics for *Environmental Engineering in Industry*, and in The Faculty of Horticulture for *Environmental Engineering in Agriculture*.

The aim of these faculties is to promote partnerships, to develop and deliver innovative strategies and programs related to improving integrated planning and natural resource management.

The applied research conducted or supervised by faculties' staff addresses needs articulated by the social and economic regional partners. In same time the faculties' staffs is preoccupied to find opportunities for students to direct their research skills at real-world problems in integrated natural resource management and sustainable development.

A primary goal is to create collaborative and interdisciplinary approach to assist government agencies, local and regional communities and industrial companies for better meet of the changing needs into: new technologies and industries; intensified reuse of materials and equipment; migration to renewable energy sources; more

efficient use of natural resources; global climate change and its effects on population and industry and agriculture; creating profitable new ventures which are environmentally sustainable; targeting and penetrate newly emerging green industry markets; incorporating environmental concerns into strategic planning at all levels.

As a research and outreach curricula program, the sustainable development initiatives must seek to facilitate a healthy, profitable industrial and agricultural environmental activities within the framework of long term economic sustainability.[1,2,4]

The academic curricula level identifies, supports and conducts education and research into opportunities and constraints environmental issues pose for regional sustainable development, and acts as a resource for curriculum development and student education.[3]

In their broader functions the faculties provide practical translations of cutting edge, scientific research to facilitate applications in operations, policy setting and product development. There are offered informative programs on vital issues related to sustainability, providing a platform for new ideas and technologies, and foster dialogue between relevant stakeholders on issues of regional economic problems, technological development and environmental change.

The faculties promote networking activities which main goals are to:

- enhance dissemination of information
- promote discussion of important issues among stakeholders
- broaden understanding of the needs of business and other relevant stakeholders
- stimulate interdisciplinary collaborative programs which involve and engage the faculties' students
- identify research topics.

The research activity concurrently promotes and carries on critical research, while fostering a process of curriculum development as the natural outcome of research involvement and interest.

The research and information gathering activities focus on:

- environmental degradation
- new and changing industries and developing markets
- structural adjustment
- global climate change impact
- natural resource usage
- renewable and alternative energy
- waste generation and re-use
- waste reduction, recycling and re-use
- environmentally sound building practices

5 Conclusion

The curricula and research programmes of the Faculty of Electomechanics for *Environmental Engineering in Industry*, and in the Faculty of Horticulture for *Environmental Engineering in Agriculture* include, among other subjects, the environment and the proper use of resources; basic scientific research and the application of the results of science and technology in the interests of sustainable development.

A central theme of the teaching activity is to focus on skills and techniques which can be used in engineering design and management to ensure that the wider whole life costs and impacts of engineering schemes are addressed at every stage of planning, implementation and disposal.

Overlaying this is the need to explore value frameworks for engineers so that the differing attitudes and motives of those involved in trying to find ways of making sustainable development principles work, can be understood.

Ways in which these sustainability ideas can be introduced into engineering organizations, in both the public and private sectors, through change management are also developed.

Another element of the programme is to demonstrate through real life examples the tangible benefits which have already been achieved in many engineering projects, and to highlight how real improvements, can, and are, being made.

Elements of University strategically policy, the technical innovation in environmental engineering are driven by the need to deliver a more sustainable development future.

This widespread acceptance of the need for Sustainable Development is a tacit recognition that the past and present strategies of industrial societies have led to unacceptable damage of the physical environment and inequalities both within "developed" communities and with the rest of the non-industrialized communities.

The environmental engineering education for sustainable development focuses on the following key areas, which we believe are essential for well informed engineers to tackle the issues facing the modern world:

- the need to engage in problem definition through careful dialogue with all stakeholder groups and a proper recognition of context
- an understanding of mechanisms for managing change in organizations so future engineers are equipped to play a leadership role

- an acknowledgement that technical innovation and environmental managing skills also must be understood and combined as precursors to the successful implementation of sustainable solutions

There is now a professional duty on engineers to formulate systems, technologies and attitudes that will deliver a more sustainable approach across all sectors of engineering.

Global warming, climate change, resource depletion, wastefulness and pollution generation are some of the difficult problems we face.

Engineers have a special place in being able to develop solutions and new strategies to deal with these critical subjects, whilst also providing the necessary tools to address global poverty and health issues.

Realistically, solutions to these problems will not be generated overnight and the challenge is in finding robust ways of implementing sustainability at a practical level.

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