WamPPP - WP 1

AN ANALYSIS OF THE EXISTING STUDY PROGRAMMES IN THE FIELD OF WASTE MANAGEMENT IN THE REPUBLIC OF SERBIA

Prepared by:

With regard to the main project activities, outcomes and results and for the purposes of implementing the Work Package 1 and the current work package, partner institutions have conducted a research in all higher education institutions in Serbia.

By implementing the said activity (1.1. An analysis of the existing study programmes in the field of waste management) we had obtained various data which have been made part of a report and can be used as an input into other project activities. The report comprises information regarding courses and study programmes in higher education institutions dealing with the issues of waste management.

The data have been obtained through the Internet, by means of partner institutions, on the basis of the data obtained from the Commision for Accreditation and Quality Control, as well as on the website of the Statistical Office of the Republic of Serbia.

The implementation of this activity was based on data collection and analysis, as well as on report compiling.

In the academic year of 2015/2016 some 51855 students enrolled for the first year of study in the Republic of Serbia.[1] According to data from 2013/2014 there were 242848 students in Serbia, while 50728 student graduated in the said academic year[2]. The details have been provided in Tables 1 and 2.

Table 1: Data on students who enrolled for the first year of study in the academic 2015/2016.

Republic of Serbia	51855
Public faculties	31500
Private faculties	5934
Public colleges	12868
Private colleges	1553
Vojvodina	11209
Public faculties	7833
Private faculties	1282
Public colleges	5879
Private colleges	1134
Belgrade region	26674
Public faculties	15670
Private faculties	3991
Public colleges	5879
Private colleges	1134
Central and Western Serbia	7172
Public faculties	3595
Private faculties	377
Public colleges	2916
Private colleges	284

[1] Statistical Office of the Republic of Serbia, Report No 345, the year of LXV, 25.12.2015. http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/97/39/AS10_345-srb.pdf

[2] Statistical Office of the Republic of Serbia: http://webrzs.stat.gov.rs/WebSite/repository/documents/00/01/99/82/16_2015.pdf

Southern and Eastern Serbia	6800
Public faculties	4402
Private faculties	284
Public colleges	2114
Private colleges	-

Table 2: Data on the number of students who were studying in the academic year of 2013/2014 presented by regions

		Colleges		**Faculties**	
Region	Total	N° of schools	N° of students	N° of faculties	N° of students
Republic of Serbia	242848	56	48052	124	194796
Vojvodina	54364	10	8548	26	45819
Belgrade region	129177	22	22060	67	107117
Central and Western Serbia	30211	14	9939	16	20272
Southern and Eastern Serbia	29093	10	7505	15	21588

For the purposes of facilitating the analysis and presentation of study programmes, the Republic of Serbia was divided into the following regions: the Autonomous Province of Vojvodina, the city of Belgrade, Central and Western Serbia, as well as Southern and Eastern Serbia (including Kosovo and Metohija). In the enclosed tables there are lists of higher education institutions in which various courses deal with the issue of waste management.

We have identified 49 higher education institutions in total (23 faculties and 26 colleges) which offer courses in the field of environmental protection and waste management, which comprises 19% of all faculties and 46% of all colleges. For the purposes of obtaining more detailed information in the following phase of the analysis, we have conducted a classification of courses and study programmes. Partner institutions had analysed the syllabi and curricula of all study programmes at higher education institutions which enjoy the status of legal entities in Serbia, and the results were presented by regions. The aim of the research was to determine the courses offered at higher education institutions which deal with waste management, i.e. environmental protection.

Indicators

In the tables presented below one can observe faculties and vocational colleges which offer at least one course dealing with the issue of waste management, or with the field of environmental protection. In order to analyse study programmes dealing with environmental protection, i.e. study programmes dealing with waste management, and for the purposes of quantitative and qualitative evaluation of their contents, certain indicators have been introduced. The indicators dealing with higher education institutions and their programmes are as follows:

1) the number of courses dealing with waste management;
2) the number of study programmes offering at least one course dealing with waste management;
3) the number of compulsory courses dealing with waste management;
4) the maximum number of students who attend at least one course dealing with waste management (note: in the case of elective courses we have included the total number of students who enrol for the first year and for the particular study programme within which the course is attended; in case of all courses we have included the number of students who enrol for the first year of studies, regardless of the year of study in which the course is attended);
5) the number of courses which deal with environmental protection, or at least partly deal with the field of waste management;
6) the number of study programmes comprising at least one course dealing with environmental protection;
7) the number of compulsory courses from related fields;
8) the maximum number of students who attend at least one course dealing with environmental protection.

With respect to introducing data into tables the number of the said indicators (from 1 to 8) corresponds with the items in the tables (from 1 to 8). The same indicators have been used with master academic studies and specialist vocational studies.

Table 3: Value indicators for faculties in Vojvodina

		Undergraduate studies								**Master/specialist studies**							
N°	**Faculties**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	Faculty of Agriculture in Novi Sad	1	7	0		5	7	2									
2.	Faculty of Technology in Novi Sad	3	6	0		5	6	2									
3.	Faculty of Technical Science in Novi Sad	4	3	3		1	3	0									
4.	Faculty of Sciences in Novi Sad	1	2	0		5	2	1									
5.	Faculty of Technical Science „Mihajlo Pupin“ in Zrenjanin	2	2	1		8	2	2									
6.	Faculty of Environmental Protection (Educons University) in Sremska Kamenica	0	1	0		2	1	0									
7.	Faculty of Economics and Engineering Management (Fimek) in Novi Sad	0	1	0		1	1	0									
	SUM:	**11**	**22**	**4**		**27**	**22**	**7**									

Tables from 3 to 10 present one with the values of indicators for the higher education institutions which deal with the issue of waste management.

Table 4: Value indicators for colleges in Vojvodina

		Undergraduate studies								Master/specialist studies							
N°	**Colleges**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	College of Applied Technical Sciences in Novi Sad	2		2		0		0									
2.	College of Applied Technical Sciences in Zrenjanin	1		0		2		0									
	SUM:	**3**		**2**		**2**											

Table 5: Value indicators for faculties in Belgrade region

		Undergraduate studies								Master/specialist studies							
N°	**Faculties**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	Faculty of Technology and Metallurgy	8	4	4		8	4			3	1	-		3	1		
2.	Faculty of Mining and Geology	5	1	5		5	1			1	1	1		1	2		
3.	Technical Faculty in Bor	6	2	4		6	2			-	1	-		-	2		
4.	Faculty of Mechanical Engineering	1	1	-		1	1			-	-	1		-	-		
5.	Faculty of Applied Ecology - Futura	3	1	1	80	3	1			1	1	-	75	1	3		
6.	Faculty of Forestry	-	-	-		-	1			-	-	-		-	-		
7.	Faculty of Geography - Belgrade	1	1	1		1	1			-	-	-		-	-		
8.	Faculty of Chemistry in Belgrade	1	1	1		1	1			-	-	-		-	1		
9.	Faculty of Ecology and Environmental Protection - Union Nikola Tesla	1	1	1	75	1	1			2	2	1	62	-	2		
	SUM:	**26**	**12**	**17**	**155**	**26**	**13**			**7**	**6**	**3**		**5**	**11**		

Table 6: Value indicators for colleges in Belgrade region

		Undergraduate studies								Master/specialist studies							
N°	**Colleges**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	Belgrade Polytechnics College	8	2	8	120	8	2			-	-	-	-	-	-		
2.	College of Applied Technical Sciences – Požarevac	2	1	-		2	1			1	1	-		1	1		
3.	Railway College of Applied Studies in Belgrade	1	1	-	60	1	1			-	-	-	30	1	1		
	SUM:	**11**	**4**	**8**	**184**	**11**	**4**			**1**	**1**			**2**	**2**		

Table 7: Value indicators for faculties in Central and Western Serbia

		Undergraduate studies								Master/specialist studies							
N°	**Faculties**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	Faculty of Technical Science - Čačak	0	1	0	30	3	4	0	145	0	0	0	0	1	1	0	32
2.	Faculty of Agriculture in Čačak	0	0	0	0	1	4	0	120	0	0	0	0	3	2	0	48
3.	Faculty of Sciences - Kragujevac	0	0	0	0	9	3	7	135	0	0	0	0	1	1	0	30
4.	Faculty of Economics- Kragujevac	0	0	0	0	1	2	1	600	0	0	0	0	0	0	0	0
5.	Faculty of Medical Sciences - Kragujevac	0	0	0	0	1	1	1	88	0	0	0	0	0	0	0	0
6.	Faculty of Engineering - Kragujevac	2	1	2	12	3	1	3	12	0	0	0	0	0	0	0	0
7.	Faculty of Mechanical Engineering - Kraljevo	0	0	0	0	2	1	0	120	0	0	0	0	1	1	0	64
8.	University in Novi Pazar	0	0	0	0	1	1	0	80	0	0	0	0	1	1	0	10
9.	Faculty of Hotel Management and Tourism in Vrnjačka Banja	0	0	0	0	1	1	1	100	0	0	0	0	0	0	0	0
	SUM:	**2**	**2**	**2**	**42**	**22**	**18**	**13**	**1400**	**0**	**0**	**0**	**0**	**7**	**6**	**0**	**184**

Table 8: Value indicators for colleges in Central and Western Serbia

		Undergraduate studies								Master/specialist studies							
N°	**Colleges**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	College of Applied Technical Sciences - Čačak	0	0	0	0	1	1	1	120	0	0	0	0	0	0	0	0
2.	Business College of Applied Studies - Čačak	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	22
3.	College of Health Studies in Ćuprija	0	0	0	0	1	1	1	30	0	0	0	0	1	1	1	20
4.	College of Applied Studies in Chemical Technology - Kruševac	4	1	0	60	5	2	3	100	0	0	0	0	0	0	0	0
5.	College of Applied Technology– Aranđelovac	3	3	1	120	8	4	5	190	4	1	3	22	4	1	2	22
6.	College of Applied Technical Studies- Kragujevac	2	1	1	27	1	1	1	0	0	0	0	0	1	1	1	9
7.	Business and Technical College of Applied Studies – Užice	1	1	1	66	5	1	5	66	1	1	0	35	2	1	0	35
8.	College of Applied Technology - Šabac	1	2	1	44	5	6	3	275	0	0	0	0	2	1	1	35
9.	College of Agriculture - Šabac	0	0	0	0	3	5	3	220	0	0	0	0	1	2	1	64
	SUM:	**11**	**8**	**4**	**317**	**29**	**21**	**22**	**1001**	**5**	**2**	**3**	**57**	**12**	**7**	**6**	**207**

Table 9: Value indicators for faculties in Southern and Eastern Serbia

		Undergraduate studies								Master/specialist studies							
N°	**Faculties**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	UUNT – Faculty of Ecology and Environmental Protection - Surdulica	1	1	1	25	3	1	1	25	0	0	0	0	0	0	0	0
2.	University of Priština – Faculty of Technical Sciences	4	3	3	104	1	1	0	32	0	0	0	0	0	0	0	0
3.	University of Niš – Faculty of Mechanical Engineering	1	1	0	240	0	0	0	0	1	1	0	24	0	0	0	24
4.	University of Niš – Faculty of Occupational Safety	2	2	1	360	6	2	5	360	1	1	0	32	6	3	4	96
5.	University of Niš – Faculty of Sciences in Niš	1	1	0	20	1	1	1	60	0	0	0	0	2	1	0	27
6.	University of Niš – Faculty of Technology in Leskovac	5	3	0	120	1	1	1	60	1	1	0	16	0	0	0	0
	SUM:	**14**	**11**	**5**	**869**	**12**	**6**	**8**	**537**	**3**	**3**	**0**	**72**	**8**	**4**	**4**	**147**

Table 10: Value indicators for colleges in Southern and Eastern Serbia

		Undergraduate studies								Master/specialist studies							
N°	**Colleges**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	College of Applied Technical Sciences in Niš	2	1	2	60	7	1	4	60	1	1	1	32	3	1	0	32
2.	College of Agriculture and Food Technology in Prokuplje	1	2	0	112	0	0	0	0	0	0	0	0	0	0	0	0
3.	College of Applied Vocational Studies in Vranje	3	2	2	60	3	1	3	20	0	0	0	0	0	0	0	0
4.	College of Textile in Leskovac	4	1	3	20	0	0	0	0	1	1	1	10	4	1	1	10
5.	College of Applied Technical Sciences in Uroševac	x	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SUM:	**10**	**7**	**7**	**252**	**10**	**2**	**7**	**80**	**2**	**2**	**2**	**42**	**7**	**2**	**1**	**42**

Objectives and intended outcomes of courses

On the basis of the data presented in the tables above one can deduce that courses are divided into two groups:

- Direct courses – courses which offer training in waste management and
- Indirect courses – courses which generally deal with environmental protection, and which offer training in waste management through various teaching units.

The aims, outcomes and competences have been defined depending on the study level, scientific field and study programmes. Due to large data volume, common objectives and outcomes of direct and indirect courses have been presented.

Direct courses

The objectives are as follows:

- introducing students to the manners of generating solid waste and its forms
- introducing students to the fundamental elements of an integrated solid waste management system,
- introducing students to domestic and international regulations regarding waste management,
- transferring knowledge on methods of waste treatment and of its final disposal,
- transferring knowledge on fundamental recycling technologies, on installations and on waste streams management;
- introducing students to the methods of obtaining various forms of energy from waste,
- introducing students to the streams, management and disposal of hazardous waste,
- transferring skills in forming and conducting a plan of sustainable local and regional solid waste management.

Outcomes – upon completion of these courses students should be capable of:

- understanding the significance of an integrated waste management system,
- competently analysing domestic and global regulations in the field of solid waste management,
- applying acquired knowledge on recycling,
- contributing to the improvement of a solid waste management system through team work,
- managing energy and ecology related projects
- independently solving waste management issues and implementing the acquired knowledge.

Indirect courses

The objectives are as follows:

- transferring knowledge on environmental protection and sustainable development,
- introducing students to the basic ecological factors, pollutants, sources of pollution and polluting substances,
- introducing students to measures for environmental protection, for protection of flora and fauna, protection from food pollutants, from sources of pollution and polluting substances, as well as for environmental monitoring,
- transferring knowledge on waste management, recycling, treatment and final disposal of waste
- introducing students to climate changes, biodiversity and environmental protection,
- transferring knowledge on and skills in preventive and operational activities at work, and raising awareness regarding the necessity of environmental protection,
- introducing students to domestic and international regulations regarding environmental protection

Outcomes – upon completion of these courses students should be capable of:

- analysing and solving problems regarding environmental protection and sustainable development at a local and global level,
- being a part of the team which would manage the municipality system and quality of the environment
- using professional literature, collecting and interpreting necessary information, and solving complex issues in the field of environmental protection by applying acquired knowledge.

In all these higher education institutions objectives and outcomes are in accordance with the objectives and outcomes of study programmes. Higher education institutions along with the lists of direct and indirect courses, i.e. the lists of compulsory and elective courses in the field of waste management and environmental protection, have been presented in the tables below (11 to 14).

Table 11: An overview of higher education institutions with study levels, names of courses and their status in the Autonomous Province of Vojvodina.

N°	Institution	Name of the course (D/I[3])	Study level	Course status	
				C - compulsory	*E- elective
Faculties					
1.	Faculty of Agriculture	• Fundamentals of Environmental Management (I) • Environment and Natural Resource Management (I), • Ecological Engineering and Occupational Safety (I) • Waste Materials and Environmental Protection (D) • Environment and Sustainable Development (I) • Natural Resource Management (I).	Undergraduate	-C -C	-*E -*E -*E -*E -*E
2.	Faculty of Technology in Novi Sad	• Environmental Protection (I) • Water and Waste Water Technology (D), • Environmental Protection in Food Biotechnology (I) • Sustainable Development and Industrial Systems (I) • Solid Waste and Hazardous WasteTechnology (D) • Environmental Protection in Pharmaceutical Industry (I) • Environmental Protection in Chemical Industry (I) • Recycling of Polymers (D)	Undergraduate	-C -C	-*E -*E -*E -*E -*E -*E

[3] D/I: D-direct, I-indirect

3.	Faculty of Technical Sciences in Novi Sad	• Energy Utilisation of Waste Technology (D) • Solid Waste Management (D) • Hazardous Waste Management (D) • Process Equipment for Environmental Protection (I) • Characterisation of Recyclable Materials (D)	Undergraduate	-C -C -C	-*E -*E
4.	Faculty of Sciences in Novi Sad	• Environment and Sustainable Development (I) • Fundamentals of Environmental Protection (I) • Fundamentals of Environmental Management (I) • Technology of Environmental Protection (I) • Quality Management Systems (I), • Solid Waste (D)	Undergraduate	-C	-*E -*E -*E -*E -*E
5.	Faculty of Technical Sciences „Mihajlo Pupin“ in Zrenjanin	• Ecological Engineering (I) • Integrated Pollution Register (I) • Chemical Principles in Environmental Protection Engineering (I) • Environmental Monitoring (I) • Business Ecology (I) • Solid Waste Management (D) • Hazardous Waste Management (D) • Process Equipment for Environmental Protection (I) • The EMS Systems (I) • Mechanical Engineering in Environmental Protection (I)	Undergraduate	-C -C -C -C	-*E -*E -*E -*E -*E -*E

6.	Faculty of Environmental Protection in Sremska Kamenica	• Environmental Protection and Risk Management (I) • Management of Technological Development (I).	Undergraduate	-C	-*E
7.	Faculty of Economics and Engineering Management in Novi Sad	• Technology of Environmental Protection (I).	Undergraduate	-C	
Colleges					
1.	College of Applied Technical Sciences in Novi Sad	• Soil Protection and Solid Waste (D) • Environmental Protection (I)	Undergraduate	-C -C	
2.	College of Applied Technical Sciences in Zrenjanin	• Ecology and Environmental Protection (I) • Solid Waste Management (D) • Environmental Protection Management(I)	Undergraduate		-*E -*E -*E

Table 12: An overview of higher education institutions with study levels, names of courses and their status in Belgrade region

N°	Institution	Name of the course (D/I[4])	Study level	Course status	
				C- compulsory	*E- elective
Faculties					
1.	Faculty of Technology and Metallurgy	• Solid Waste Management (D) • Fundamentals of Waste Water Technology (D) • Purification of Waste Gases (D) • Purification of Industrial Waste Water (D) • Recycling (D) • Polymers Processing and Recycling (D) • Materials Recycling (D) • Metal Recycling (D)	Undergraduate	- C - C - C - C	-*E -*E -*E -*E
		• Solid and Hazardous Waste Management (D) • Advanced Technologies in Waste Water Treatment (D)	Master		-*E -*E

[4] D/I: D-direct, I-indirect

		• Radioactive Waste Management (D)			-*E
2.	Faculty of Mining and Geology	• Characterisation and Waste Management D) • Purification of Waste Water (D) • Industrial Waste Disposal (D) • Waste Preparation and Recycling (D) • Municipal Solid Waste Sorting and Recycling Methods (D)	Undergraduate	- C - C - C - C	-*E
		• Hazardous Waste Treatment, Storage and Disposal (D)	Master	- C	
3.	Faculty of Technical Sciences in Bor	• Waste Water (D) • Technology of Treatment and Disposal of Solid Waste (D) • Purification of Waste Gases (D) • Waste Treatment and Management (D) • Recycling Technology (D)	Undergraduate	- C - C - C -C	-*E -*E
		• Landfill Design (D) • Hazardous Waste Management (D)	Master		-*E -*E
4.	Faculty of Mechanical Engineering in Belgrade	• Solid Waste and Waste Water Management	Master	- C	
5.	Futura – Faculty of Applied Ecology	• Municipal Waste (D) • Industrial and Hazardous Waste (D) • Integrated Waste Management (D)	Undergraduate	- C	-*E -*E
		• Technology of Waste Stream Processing (D)	Master		
6.	Faculty of Forestry in Belgrade	• Water Protection (I)	Undergraduate	- C	
7.	Faculty of Geography in Belgrade	• Waste Management (D)	Undergraduate	- C	
8.	Faculty of Chemistry in Belgrade	• Water and Waste Water Chemistry (D) •	Undergraduate	- C	

9.	Faculty of Ecology and Environmental Protection - Union Nikola Tesla, Belgrade	• Waste Management (D)	Undergraduate	- C	
		• Drinking Water and Waste Water Treatment Principles: semester I, elective (D) • Hazardous Waste Mangement (D)	Master	 - C	-*E
Colleges					
1.	Belgrade Polytechnics	• Solid and Hazardous Waste (D) • Recycling Processes (D) • Recyclable Waste Management (D) • Operations and Equipment in the Recycling Process (D) • Physicochemical Processes in Recycling (D) • Recycling Technologies 1 (D) • Recycling Technologies 2 (D) • Logistics of Waste Materials (D)	Undergraduate	- C - C - C - C - C - C - C - C	
2.	College of Applied Technical Sciences – Požarevac	• Waste Treatment and Recycling (D) • Waste Water Treatment (D)	Undergraduate	- C	-*E
3.	Railway College of Applied Studies in Belgrade	• Collection and Recycling of Waste (D)	Undergraduate		-*E

Table 13: An overview of higher education institutions with study levels, names of courses and their status in Central and Western Serbia

N°	Institution	Name of the course (D/I[5])	Study level	Course status	
				-C compulsory	-*E- elective
Faculties					
1.	Faculty of Technical Sciences – Čačak	• Waste Management (D) • Ecology (I) • Logistics Systems (I) • The System of Environmental Quality (I)	Undergraduate		-*E -*E -*E -*E
		• Eco-Design and Environment (I)	Master		-*E

[5] D/I: D-direct, I-indirect

2.	Faculty of Agriculture in Čačak	• Ecology and Environmental Protection (I)	Undergraduate		-*E
		• Environmental Microbiology (I) • Improvement and Protection of Agro-Ecosystems (I)	Master		-*E -*E
3.	Faculty of Sciences - Kragujevac	• Environmental Protection (I) • Ecological Monitoring of the Environment (I) • Evaluation of Environmental Impact (I) • Restoration and Improvement of Ecosystems (I) • Industrial Pollutants (I) • Standards in Environmental Protection (I) • Fundamentals of Ecology (I)	Undergraduate	-C -C -C -C	-*E -*E -*E
		• Medical Aspects of Environmental Protection (I)	Master		-*E
4.	Faculty of Economics - Kragujevac	• Tourism and Environment (I)	Undergraduate		-*E
5.	Faculty of Medical Sciences - Kragujevac	• Hygiene and Ecology (I)	Master	-C	
6.	Faculty of Engineering Sciences - Kragujevac	• Energy and the Environment (I) • Principles of Sustainable Development of Urban and Rural Areas (I) • Management of Energy and Ecology Projects (I) • Waste Management (D) • Recycling Technologies (D)	Undergraduate	-C -C -C -C	-*E
7.	Faculty of Mechanical Engineering - Kraljevo	• Environmental Protection (I) • Technologies and Facilities for Waste Management (D)	Undergraduate		-*E -*E
8.	State University in Novi Pazar	• Environmental Law (I) • Environmental Protection (I)	Undergraduate		-*E -*E
9.	Faculty of Hotel Management and Tourism in Vrnjačka Banja	• Tourism and Environmental Protection (I)	Undergraduate	-C	

Colleges					
10.	College of Applied Technical Sciences - Čačak	• Environmental Protection (I)	Undergraduate	-C	
11.	Business College of Applied Studies - Čačak	• Environmental Management (I)	Specialist		-*E
12.	College of Health Studies in Ćuprija	• Toxicological and Environmental Chemistry (I)	Undergraduate	-C	
		• Living and Working Environment and Health (I)	Specialist	-C	
13.	College of Applied Studies in Chemical Technology - Kruševac	• Recycling (D) • Toxicology and Protection from Toxic Substances (I) • Management of Working and Living Environment (I) • Environmental Protection (I) • Occupational Safety and Waste Management (D) • Technology of Water Purification (D)	Undergraduate	- C	-*E -*E -*E -*E -*E
14.	College of Applied Technological Studies - Aranđelovac	• Waste Management (I) • Recycling of Radioactive Waste Materials (D) • Recycling od Metal Materials and Electronic Waste (D) • Fundamentals of Environmental Science (I) • Environmental Protection and Sustainable Development (I) • Environmental Projects (I) • Environmental Impact of Transport (I) • Construction and Sustainable Development (I) • Application of Geographic Information Systems in Environmental Management (I) • Fundamentals of Environmental Science in Tourism and Hospitality (I) • Sanitation and Safety of Food and Beverages (I)	Undergraduate	-C -C -C -C	-*E -*E -*E -*E -*E -*E

		• Recycling and Energy-from-Waste (D) • Management of Waste and Hazardous Substances (D) • Remediation of Contaminated Sites (D) • Pharmaceutical and Medical Waste (D) • Environmental Engineering (I) • Sustainable Use of Natural Resources (I) • Eco-Tourism and Environmental Protection (I) • Social Ecology (I)	Specialist	-C -C -C -C -C	-*E -*E -*E
15.	College of Applied Technical Sciences - Kragujevac	• Environmental Protection and Waste Management (D) • Recycling Materials (D) • Sustainable Development of Urban Areas (I)	Undergraduate	-C -C	-*E
		• Environmental Protection Management (I) • Processing and Utilisation of Waste Materials (D)	Specialist		-C -*E
16.	Business and Technical College of Applied Studies – Užice	• WasteManagement (D) • Technologies in the Process Industry (I) • Sources of Pollution of Living and Working Environment (I) • Environmental Protection (I) • Process Equipment (I) • Eco-Protection in Industry (I)	Undergraduate	-C -C	-*E -*E -*E -*E
		• Air Analysis, Control and Protection (I) • Soil Analysis, Control and Protection (I) • Hazardous Waste and Substances (D)	Specialist		-*E -*E -*E
17.	College of Applied Technological Studies - Šabac	• Waste Management (D) • Fundamentals of Environmental Protection (I) • Soil Protection (I) • Environmental Monitoring (I) • Hygiene and Sanitation (I) • Energy and Environment (I)	Undergraduate	-C -C -C	-*E -*E -*E -*E -*E
		• Sustainable Development (I)	Specialist	-C	

18.	College of Agriculture - Šabac	• Ecology (I) • Techical Aspects of Environmental Protection (I) • Environmental Law (I)	Undergraduate	-C -C -C	
		• Agro-Ecology and Environmental Protection (I)	Specialist	-C	

Table 14: An overview of higher education institutions with study levels, names of courses and their status in Southern and Eastern Serbia

N°	Institution	Name of the course (D/I[6])	Study level	Course status	
				-C compulsory	-*E- elective
Faculties					
1.	Faculty of Ecology and Environmental Protection	• Waste Management (D) • Fundamentals of Ecology (I) • Calculation Methods in Environmental Protection and Ecology (I) • Information Technologies in Environmental Protection and Ecology (I)	Undergraduate	-C -C	-*E -*E
2.	University of Priština – Faculty of Technical Sciences	• Hazardous Waste Management (D) • Solid Waste Treatment and Disposal Technology (D) • Recycling Material Technology (D) • Waste Water Treatment (D) • Waste Gases Treatment (I)	Undergraduate	-C -C -C	-*E -*E
3.	University of Niš – Faculty of Mechanical Engineering	• Waste Water Treatment (D)	Undergraduate		-*E
		• Solid Waste Management (D)	Master		-*E
4.	Faculty of Occupational Safety	• Waste Management (D) • Purification of Hazardous Industrial Substances (D) • Risk of Hazardous Substances (I) • Air Protection (I) • Water Protection (I) • Soil Protection (I) • Sustainable Development (I) • Ecology (I)	Undergraduate	-C -C -C -C -C -C	-*E -*E

[6] D/I: D-direct, I-indirect

		• Municipal Waste Management (D) • Technological Processes and the Environment (I) • Urban Ecology (I) • Environmental Monitoring (I) • Eco-Toxicology (I) • Environmental Protection Management (I) • Local Sustainable Development (I)	Master	-C -C -C -C	-*E -*E -*E
5.	University of Niš – Faculty of Sciences	• Working with Hazardous Organic Substances (D) • General Ecology (I)	Undergraduate	-C	-*E
		• Urban Ecology (I) • Global Ecology (I)	Master		-*E -*E
6.	University of Niš – Faculty of Technology in Leskovac	• Management of Noxious and Hazardous Substances (D) • Waste Water Treatment (D) • Polymers Recycling (D) • Solid Waste Treatment (D) • Bioprocesses in Environmental Protection (D) • Environmental Protection Engineering (I)	Undergraduate	-C	-*E -*E -*E -*E -*E
		• Management of Hazardous Waste (D)	Master		-*E
Colleges					
1.	College of Applied Technical Sciences in Niš	• Waste Management (D) • Recycling Technologies (D) • Introductory Principles of Environmental Protection (I) • Eco-Standards and Technical Regulations (I) • Industrial Ecology (I) • Environmental Engineering (I) • Eco-Design (I) • Measurement and Control of Environmental Parameters (I) • Sustainable Development (I)	Undergraduate	-C -C -C -C -C -C	 -*E -*E -*E
		• Technology of Waste Treatment (D) • Environmental Protection Monitoring (I)	Specialist	-C -C	 -*E

		• European Environmental Protection Standards and Directives (I) • Life Cycle Analysis (I)			-*E
2.	College of Agriculture and Food Technology in Prokuplje	• Waste Water Technology (D)	Undergraduate		-*E
3.	College of Applied Vocational Studies in Vranje	• Industrial and Hazardous Waste (D) • Ecology and Environmental Protection (I) • Environmental Biotechnologies (I) • Water and Waste Water Chemistry (D) • Transport of Hazardous Substances (D) • Sustainable Development (I)	-C -C -C -C -C		-*E
4.	College of Textile in Leskovac	• Management of Hazardous Substances (D) • Waste Management (D) • Recycling ofTextiles and Clothing (D) • Recycling Technologies (D)	-C -C -C		-*E

Data analysis

On the basis of indicators provided in the tables above one can conclude that a maximum number of 5558 undergraduate, specialist or master students attend some sort of courses dealing with the field of waste management or environmental protection, which is less than 20% of all students in Serbia (Table 2). In practice, this number is even smaller because numerous higher education institutions fail to enrol the estimated number of students or, on the other hand, students give up their studies.

The analysis has identified the total number of 87 courses which deal with waste management within 66 undergraduate study programmes, as well as 18 courses at the graduate level, within 14 study programmes. Likewise, it has been established that there are 137 courses within 85 undergraduate study programmes which deal with environmental protection, i.e. 41 courses within 32 graduate study programmes.

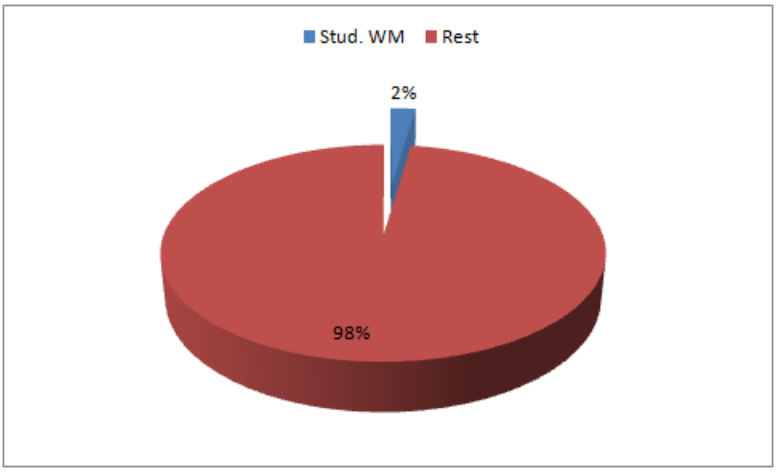

Figure 1. The share of students who attend some kind of course dealing with waste management or environmental protection

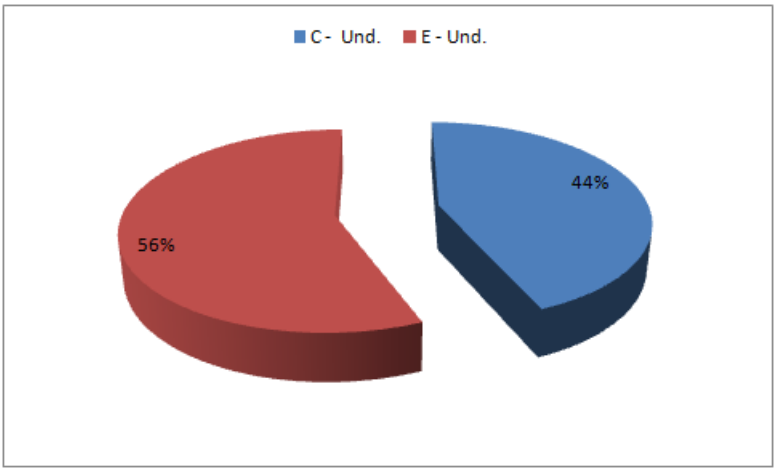

Figure 2. The ratio between the total number of compulsory and elective direct courses

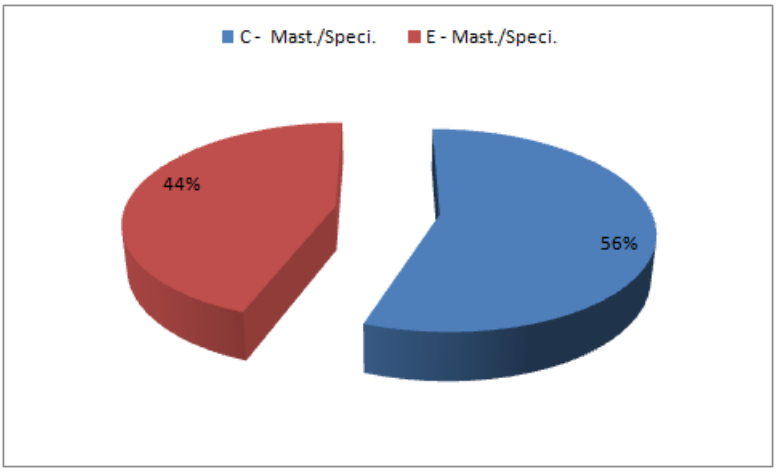

Figure 3. The ratio between the total number of compulsory and elective direct courses

Figures 2 and 3 show the ratio between direct elective and compulsory courses which deal with waste management. Their ratio is approximately equable, which is not in compliance with the recommended number of elective courses in the curricula. This issue could easily be

resolved by turning elective courses into compulsory, or by introducing new compulsory courses in the field of waste management.

On the other hand, on the basis of the presented indicators one can conclude that the total number of direct courses within specialist and master studies which deal with waste management is approximately four times smaller than within undergraduate studies. This can partly be attributed to the duration of master and specialist studies in comparison to undergraduate studies (Figure 4).

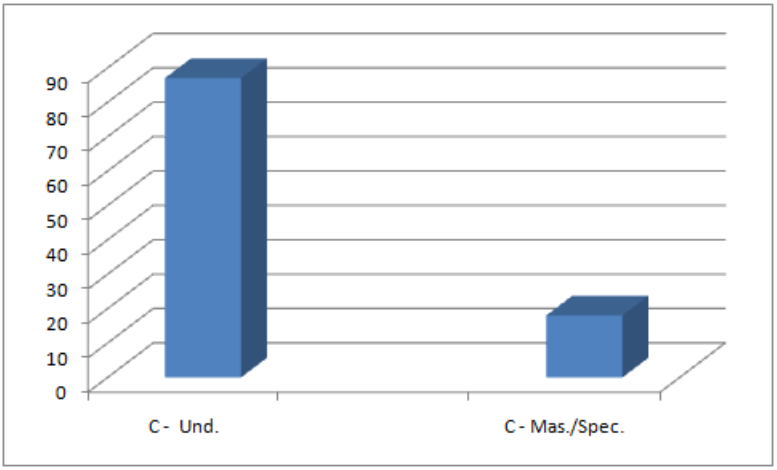

Figure 4. The ratio between the total number of direct courses within undergraduate and master/specialist studies

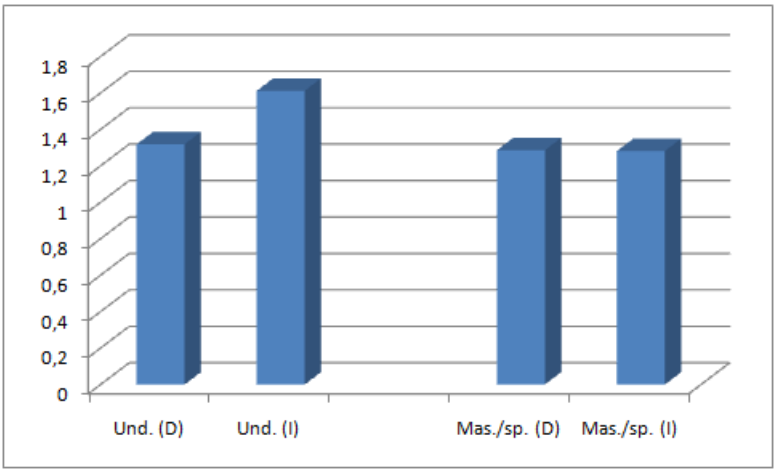

Figure 5. The average number of direct and indirect courses within undergraduate and master/specialist studies per study programme

However, the average number of direct and indirect courses on undergraduate and master studies within analysed study programmes is 1,38 (Figure 5), i.e. less than two courses per study programme, which is far below the number of courses necessary for quality education of much needed professionals in the field of waste management in Serbia.

The courses most frequently taught in the field of waste management and environmental protection are as follows: Waste Management, Environmental Protection, Sustainable Development and various forms of Ecology (for example, Solid Waste Management or Municipal Waste Management).

General conclusions of the report and recommendations for the improvement of the current situation in the field of waste management in Serbia

On the basis of the analysed data within the Work Package 1 (1.1 i 1.2) one can conclude that one of the negative factors appears to be a small number of professionals who should constitute the pillars of waste management and recycling development. A possible improvement of study programmes should include an introduction of a larger number of direct and indirect courses which would enable education of a larger number of professionals capable of contributing to a long-term elimination of negative trends in the field of waste management.

The syllabi of new indirect courses should be supplemented with the content which deals with environmental protection and waste management. Likewise, the number of study programmes directly dealing with waste management should be increased, both at master and undergraduate levels, as well as at the current specialist studies.

The introduction of vocational master studies aims at training the staff capable of solving issues regarding waste management and environmental protection in accordance with the National Strategy of Waste Management and Chapter 27 to EU Accession.

ENCLOSURE: An overview of higher education institutions, study programmes and courses dealing with waste management

Table 1. An overview of higher education institutions, study programmes and courses in Vojvodina

N°	Institution	Website	Study programme (yes/no)	Course (yes/no)
Faculties				
1.	Faculty of Agriculture in Novi Sad	http://polj.uns.ac.rs	Yes	Yes
2.	Faculty of Technology in Novi Sad	http://www.tf.uns.ac.rs	No	Yes
3.	Faculty of Technical Sciences in Novi Sad	http://www.ftn.uns.ac.rs/691618389/fakultet-tehnickih-nauka	Yes	Yes
4.	Faculty of Sciences in Novi Sad	https://www.pmf.uns.ac.rs	Yes	Yes
5.	Faculty of Technical Sciences „Mihajlo Pupin“ in Zrenjanin	http://www.tfzr.uns.ac.rs	Yes	Yes
6.	Faculty of Environmental Protection in Sremska Kamenica	http://www.educons.edu.rs/fakultet-zastite-zivotne-sredine/fakultet-zastite-zivotne-sredine	Yes	Yes
7.	Faculty of Economics and Engineering Management in Novi Sad	http://www.fimek.edu.rs/sr	Yes	Yes
Colleges				
8.	College of Applied Technical Sciences in Novi Sad	http://vtsns.edu.rs	Yes	Yes
9.	College of Applied Technical Sciences in Zrenjanin	http://www.vts-zr.edu.rs	Yes	Yes

Table 2. An overview of higher education institutions, study programmes and courses in Belgrade region

N°	Institution	Website	Study programme (yes/no)	Course (yes/no)
Faculties				
1.	Faculty of Technology and Metallurgy	http://www.tmf.bg.ac.rs/index.php?p1=1&p2=0&p3=0&p4=0&	Yes	Yes
2.	Faculty of Mining and Geology	http://fakulteti.edukacija.rs/drzavni-fakulteti/beograd/rudarsko-geoloski-fakultet	Yes	Yes
3.	Technical Faculty in Bor	http://www.tf.bor.ac.rs/index_en.php	Yes	Yes
4.	Faculty of Mechanical Engineering	http://www.mas.bg.ac.rs/eng/start	Yes	Yes
5.	Faculty of Applied Ecology - Futura	http://futura.edu.rs/wordpress	Yes	Yes
6.	Faculty of Forestry	http://www.sfb.bg.ac.rs	Yes	No
7.	Faculty of Geography - Belgrade	http://www.gef.bg.ac.rs	Yes	Yes
8.	Faculty of Chemistry in Belgrade	http://www.chem.bg.ac.rs	Yes	Yes
9.	Faculty of Ecology and Environmental Protection - Union Nikola Tesla	http://www.fpb.edu.rs/?gl_pgl=100&gl_pgr=3&gl_subnv=r	Yes	Yes
Colleges				
10.	Belgrade Polytechnics College	http://www.politehnika.edu.rs/eng/#!/beogradska-politehnika/o-skoli	Yes	Yes
11.	College of Applied Technical Sciences – Požarevac	http://www.vts-pozarevac.edu.rs	Yes	Yes
12.	Railway College of Applied Studies in Belgrade	http://www.vzs.edu.rs/vzs	Yes	Yes

Table 3. An overview of higher education institutions, study programmes and courses in Central and Western Serbia

N°	Institution	Website	Study programme (yes/no)	Course (yes/no)
Faculties				
1.	Faculty of Technical Sciences - Čačak	http://www.ftn.kg.ac.rs	Yes	Yes
2.	Faculty of Agriculture in Čačak	http://afc.edu.rs	Yes	Yes
3.	Faculty of Sciences - Kragujevac	http://www.pmf.kg.ac.rs	Yes	Yes
4.	Faculty of Economics- Kragujevac	www.ekfak.kg.ac.rs	No	Yes
5.	Faculty of Medical Sciences - Kragujevac	http://www.medf.kg.ac.rs	No	Yes
6.	Faculty of Engineering - Kragujevac	www.mfkg.kg.ac.rs	No	Yes
7.	Faculty of Mechanical Engineering - Kraljevo	www.mfkv.kg.ac.rs	No	Yes
8.	University in Novi Pazar	www.np.ac.r	Yes	Yes
9.	Faculty of Hotel Management and Tourism in Vrnjačka Banja	www.hit-vb.kg.ac.rs	No	Yes
Colleges				
10.	College of Applied Technical Sciences - Čačak	http://www.visokaskolacacak.edu.rs	No	Yes
11.	Business College of Applied Studies - Čačak	http://www.vpscacak.edu.rs/about.html	No	Yes
12.	College of Health Studies in Ćuprija	http://www.vmscuprija.edu.rs	No	Yes
13.	College of Applied Studies in Chemical Technology - Kruševac	http://www.vhts.edu.rs	Yes	Yes
14.	College of Applied Technology– Aranđelovac	http://www.vtsar.edu.rs	Yes	Yes
15.	College of Applied Technical Sciences- Kragujevac	www.vtsar.edu.rs	Yes	Yes
16.	Business and Technical College of Applied Studies – Užice	http://www.vpts.edu.rs	Yes	Yes
17.	College of Applied Technology - Šabac	http://www.vtssa.edu.rs	Yes	Yes
18.	College of Agriculture - Šabac	http://www.vpssa.edu.rs	Yes	Yes

Table 4. An overview of higher education institutions, study programmes and courses in Southern and Eastern Serbia

N°	Institution	Website	Study programme (yes/no)	Course (yes/no)
Faculties				
1.	UUNT – Faculty of Ecology and Environmental Protection, Surdulica	http://www.fpb.edu.rs/?gl_pgl=100&gl_pgr=2&gl_subnv=r&gl_faty_id=4	Yes	Yes
2.	University of Priština – Faculty of Technical Sciences	http://xn--j1aebtj.xn--90a3ac	No	Yes
3.	University of Niš – Faculty of Mechanical Engineering	http://www.masfak.ni.ac.rs	No	Yes
4.	University of Niš – Faculty of Occupational Safety	http://www.znrfak.ni.ac.rs	Yes	Yes
5.	University of Niš – Faculty of Sciences in Niš	http://www.pmf.ni.ac.rs/pmf/index.php	No	Yes
6.	University of Niš – Faculty of Technology in Leskovac	http://www.tf.ni.ac.rs	No	Yes
Colleges				
7.	College of Applied Technical Sciences in Niš	http://www.vtsnis.edu.rs	Yes	Yes
8.	College of Agriculture and Food Technology in Prokuplje	http://www.vpps.edu.rs	No	Yes
9.	College of Applied Vocational Studies Vranje	http://www.visokaskola.edu.rs	Yes	Yes
10.	College of Textile Leskovac	http://www.vsstle.edu.rs	Yes	Yes
11.	College of Applied Technical Sciences in Uroševac	http://www.vtsurosevac.com	Yes	x