POLLUTION DATA TRACKING IN THE WESTERN BALKAN COUNTRIES: A STATE-OF-THE-ART REVIEW

by

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As part of the FP6 Program, a project named WEB-ENV "Development of environmental guidelines for the region of Western Balkans" dealt with the state of the environment in the region of the West Balkan countries: Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Montenegro, and Serbia. The parameters which were observed were air and water quality, solid waste pollution, soil degradation, and state of biodiversity. The results are presented as an extended mapping exercise identifying major environmental problems in each country. This paper outlines the comparative analysis of the parameters observed in the project and their respective resources. This paper also presents the impact of some polluters on the environmental condition of the countries surrounding Western Balkans. The analysis of data proves that certain areas have insufficient parameters especially in the field of ground water quality and soil degradation. Another problem in the comparative analysis was discrepancy of year of data collection. In order to get a better understanding of the environmental issue in the region it has been determined that it is necessary to provide comprehensive data monitoring via regional projects on the territory of the Western Balkans.

Key words: *pollution, Western Balkan, air, water, waste, soil degradation*

Introduction

Environment protection is a complex problem whose treatment depends both on the condition of the observed area environment and of the awareness of the community of the necessity to undertake the certain activities, as well as on the socio/economic status and standing legal regulations and other factors.

On the territory of Western Balkans, in the last two decades, there was a disharmony between the increase of the pollution in the region and the neighboring countries, on one hand, and the increasing environment quality requirements which became topical for the entire humanity, on the other hand. At the same time, the technical level of environment status monitoring and pollution problem solving has declined, or has not developed fast enough to keep up with the new standards.

Considering the aforementioned as well as the global problem of environment pollution, the EU countries, along with other developed countries, initiated the integration of the West Balkan into the solution of environmental problems. Several last decades, the problems of

the protection environment in the West Balkan countries (WBC) territory were solved partially, at local levels, or as a part of international projects.

In order to avoid doubling of the researches, as well as to determine which environmental parameters were tracked, and which were to be consequently included in the research, the project "WEB-ENV" had been organized and carried out; *Development of environmental guidelines for the region of Western Balkans* dealt with the state of the environment in the region of the WBC: Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Montenegro, and Serbia. The parameters which were observed were air and water quality, solid waste pollution, soil degradation, and state of biodiversity. The results are presented as an extended mapping exercise identifying major environmental problems in each country.

The sources used in this project are mostly the reports of the competent Ministries and other relevant national and international institutions. Analysis of the data presented within this project provides assessment of the environmental status of the individual tracked parameters in the WBC.

Comparative analysis of the parameters

Air quality

The air quality problem has been observed in the urban and industrial area within the entire territory of WBC. An aggravating circumstance, too, is the unsystematic tracking of the relevant parameters of air quality in a longer time period. Also, the air quality monitoring is most frequently taken as a daily average of certain parameters, which does not achieve the measurement accuracy that exists in the EU. The last decade witnessed an increase in the pollutant emissions from non-stationary sources, specifically from traffic.

The quantities of CO_2, CH_4, SO_2, and NO_x in air were tracked as the very important air quality parameters.

The observation of the CO_2 and CH_4 is important because of their influence in the green house gas (GHG) effect. The results of CO_2 emission show that the highest quantity generated *per capita* is on the territory of Croatia (4841.51 kg), followed by Serbia (4324.25 kg), FYR Macedonia (FYROM) (4270 kg), and Bosnia and Herzegovina (B&H) (3270) [1-4]. The least quantity was produced in Albania and amounts to 2303 kg *per capita* (fig. 1) [5]. In figs. 2 and 3 quantities of SO_2 and NO_x *per capita* is presented, respectively.

At the national level, the highest quantity of CO_2 is generated on the territory of Serbia (33501 kT per year), followed by Croatia (21484 kT per year) and B&H (14711 kT per year).

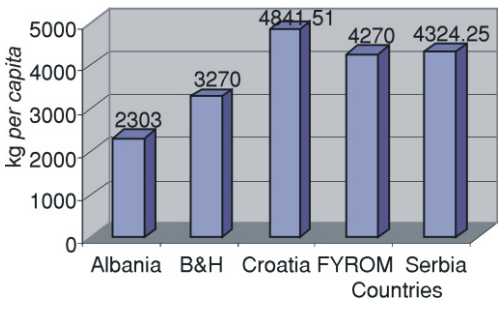

Figure 1. Quantity of CO_2 emission

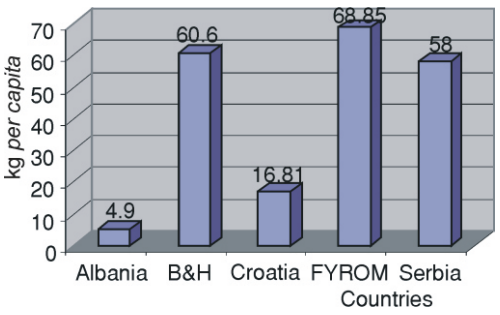

Figure 2. Quantity of SO_2 emission

Lower quantities were created in FYR Macedonia (8540 kT per year), and the least in Albania, only 1680 kT per year (tab.1).

Although CH_4 emission is very influential on the GHG, data of its emission is not followed in every country in the region.

The highest quantity of CO_2 released into the atmosphere in the neighboring countries (according to the (European Environment Agency) data) was in Greece and Romania, and varies in range 80000-110000 kT per year (the quantity in Greece is slightly increasing) (tab. 2)

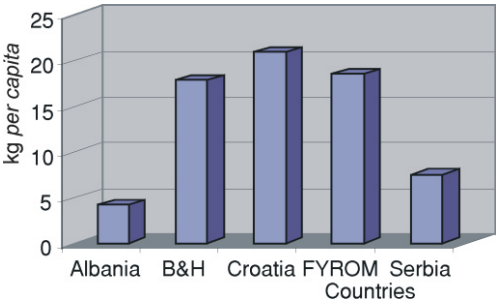

Figure 3. Quantity of NO_x emission

Table 1. Quantity of air polluters (CO_2, CH_4, SO_2, and NO_x) emitted into the atmosphere in the WBC

Country	CO_2 [kT per year]	CH_4 [kT CO_2eq]	SO_2 [kT per year]	NO_x [kT per year]
Albania	4606	2154	9.80	8.62
Bosnia & Herzegovina	14711	n. a.	272.64	80.31
Croatia	21484	3422	74.60	93.10
FYR Macedonia	8540	3741	137.70	37.20
Serbia	33501	n. a.	449.33	59.03
Montenegro	n. a.	n. a.	n. a.	n. a.

Table 2. Quantity of kT CO_2 per year in EU countries surrounding WBC

Country	1999	2000	2001	2002	2003	2004	2005	2006
Greece	90404	95375	93704	100820	100886	100445	104380	104865
Hungary	55975	55281	58420	54787	54686	52902	55429	55190
Romania	86601	71123	55393	58786	62711	72486	78247	81692
Slovenia	11779	11292	10391	10001	10870	10716	10693	10820

Comparing these data with the data related to the WBC, it may be concluded that the emission of CO_2 is much less than in the neighboring region. Such conclusion resulted from the fact that there is an insufficient technologic and economic activity in the regions, but on the other hand, it offers a potential for the trade with CER quotas, which could be a stimulus to the development of sustainable tourism and lasting environment preservation.

On the other hand, WBC region has very good potential for renewable energy resources utilization, which gives the opportunity for balanced CO_2 emission [6-8].

Regarding the EU directives, apart from the mentioned parameters, the content of NH_3, CO, heavy metals (HMs), persistent organic pollutants (POPs), and particulate matter (PM) should be monitored.

Water quality

One of the main reasons of surface and ground water pollution in the WBC is the inadequate treatment of industry and household waste. The industries in question are primarily: cement, leather, textile, wood processing, chemical, fertilizer, oil and gas processing, and mining industries.

Within the WEB-ENV project, the waste water industrial and municipal pressure at the national level of the country in the region was determined, as well as the surface water quality.

Definitely highest quantity of industrial waste water was created in the territory of B&H. The results date back to 1994. [9]. The last available data referring to Serbia and Montenegro date back to 1999, for Albania to 1997-98, and for FYR Macedonia and Croatia the data of 2004 are available [10-13]. Unfortunately, the data for Albania, Serbia, and Montenegro are not available for surface water quality monitoring.

The available data for surface water, which show the water pollution state, the biochemical oxygen demand (BOD), the chemical oxygen demand (COD), and the contents of nitrites (N), and phosphates (P) in the water are presented in tab. 3. Unfortunately, most countries in the region did not organize the complete surface water quality monitoring. Because of that, tracking of pollution in big rivers running through several countries of the region is of a great importance. One of the biggest rivers in the region is the Sava river. The Sava (945 km) is the biggest tributary to the Danube river and has a watershed of 95.55 km^2 extending over fiver

Table 3. Quality and quantity of water in WBC

Country	Waste water		Surface water quality			
	Industrial pressure [Tm^3 per year]	Municipal pressure [Tm^3 per year]	BOD [t per year]	COD [t per year]	P (phosphates) [t per year]	N (nitrates) [t per year]
Albania	1 245	n.a.	2367	n.a.	n.a.	n.a.
Bosnia & Herzegovina	750.399	191976	59297	107298	3154	10586
Croatia	138.059	252398	121585	51549	18465	4247
FYR Macedonia	274.000	214000	23530	44650	963	5365
Serbia	143.169	396601	n. a.	n. a.	n. a.	n. a.
Montenegro	n. a.	18000	n. a.	n. a.	n. a.	n. a.

countries: Slovenia, Croatia, B&H, Serbia, and Montenegro. All the countries already collaborate in the International Commission for the Protection of the Danube River (ICPDR) on the river basin management plan. Until 1991, data collection was harmonized, though lacking an in-

ventory of pollution sources, dangerous substances, socio-economic parameters, cost-benefit implications, *etc*. Later, data are incomplete due to institutional crisis (incl. warfare). Knowledge of river quality, environmental and health risk needs to be linked to pressures and their driving forces to propose remedial action. The research of the river Danube water quality is a good example how all the significant water courses of the region should be monitored.

Groundwater in the region are polluted due to the uncontrolled usage of fertilizers and chemicals, untreated sewage and leaching from contaminated soils, but there are no systematized data, so they did not included into consideration. Certainly, it was necessary to ascertain the status and source of the pollution, by and of groundwater.

Waste generation

Perhaps, the greatest problem encountered by the WBC, in terms of environmental protection is the solid waste issue. On the entire territory of West Balkan there is no completely organized system of solid waste collecting and management. Some steps are taken in Croatia, and they have already shown good results. On the Serbian territory, there are several initiatives and partial solutions; the proper approach to the solution of this global problem is expected only after the Law on waste is enforced.

At any rate, moving through the region of WBC, one encounters the "wild dumps", inappropriate municipal and regional solid waste disposal sites, inadequate management of industrial and hazardous waste. Within the WEB-ENV project, the municipal, industrial, and hazardous waste generation was observed. The highest quantity of municipal solid waste *per capita* was produced in the territory of B&H and according to the data of 2000 it amounted to 450 kg [13]. Following are Montenegro wit 365 kg (2002), Serbia with 300 kg (1999), and then Albania with 255 kg, Croatia with 253 kg (2000), and FYR Macedonia with 240 kg *per capita* [14-16]. When it comes to the industrial waste, the highest quantity was generated in the territory of Serbia, and it was, according to the data of 1999 840 kg per capita (tab. 4). The quantity in Croatia was 640 kg per capita, and in Montenegro 645 kg. The least quantity of industrial waste was in the territory of FYR Macedonia, only 82 kg. Management of *hazardous* waste is the most complex aspect of waste management, because of the high technologic demands and high costs of disposal of this kind of waste. In some parts of the region, there are some initial initiatives of in-

Table 4. Waste generation in WBC

Contry	Municipal solid waste generation		Industrial waste generation		Hazardous waste generation	
	[kg per capita]	[t per year]	[kg per capita]	[t per year]	[kg per capita]	[t per year]
Albania	255	500000	n.a.		n.a.	
Bosnia & Herzegovina	450	1912064	200	899795	49	220450
Croatia	253	1172534	640	3727273	7	37000
FYR Macedonia	240	480000	82	163400	22.5	45000
Serbia	300	2324100	840	6499733	34	260000
Montenegro	365	241956	645	427566	14	947552

cineration and sterilization, but the serious approach to this very important issue is yet to come. The data indicate that the highest quantity of dangerous waste was created in the territory of B&H 49 kg per capita, followed by Serbia with 34 kg and FYR Macedonia 22.5 kg per capita. In Montenegro 14 kg per capita was generated, and in Croatia only 7 kg. There are no available data for Albania.

Soil condition

Soil erosion, due to deforestation, poor land management practice and overgrazing of livestock is an important contribution to environmental degradation in all WBC. Soil is additionally degraded by industrial and household waste dumps. An inadequate usage of pesticides in agriculture also affected the soil degradation, especially in Albania and FYR Macedonia [17]. Considering the aforesaid, the soil erosion degree in Albania is 65%, and in FYR Macedonia territory 38% [17]. In B&H the erosion percentage is high, particularly due to open pits of coal and other substances and industrial waste dumps and it is 25.42%. The lowest erosion degree is determined for the territory of Croatia, only 4.15% [17]. There are no systematized data for the territory of Serbia and Montenegro (tab. 5).

Table 5. Soil degradation in WBC

Country	Soil degradation [%]
Albania	65.00
Bosnia & Herzegovina	25.42
Croatia	4.15
FYR Macedonia	38.00
Serbia	n. a.
Montenegro	n. a.

Biodiversity

The countries of West Balkan are well known for their rich and diversified flora and fauna. However, due to the high pollution and human neglect, a large number of animal and plant species were destroyed. The insufficient care is evident from the small number of national parks and protected areas.

In B&H only 0.7% is under protection, and in Albania 2.9% [18, 11]. Albania has a very high rate of biodiversity loss. Ten species of mammals, 16 species of birds, and 17 of fish are protected. In the territory of B&H, the number of protected species is even lower: 10 mammals, 3 bird, and 6 fish. Significantly more territory and a greater number of protected species are in Croatia and FYR Macedonia. Thus in FYR Macedonia 7.7% of the territory is under some kind of protection, including three national parks

Table 6. State of Biodiversity in WBC

Country	Number of threatened species			Endangered area [%]
	Mammals	Birds	Fish	
Albania	2	16	17	2.9
Bosnia & Herzegovina	10	3	6	0.7
Croatia	8	76	66	9.9
FYR Macedonia	16	66	30	7.3
Serbia	1	6	n. a.	6.5
Montenegro	n. a.	n. a.	n. a.	8.0

(108000 ha), three areas of special characteristics (2338 ha), and 48 natural monuments (56850 ha) [19]. The number of protected species is: mammals 16, birds 66 and fish 30. Lake Dojran, on the border between FYR Macedonia and Greece, has lost 109 out of 257 algae taxa because of excessive water extraction for agriculture.

The highest number of protected species is in the territory of Croatia, 6 species of mammals, 76 species of birds, and 66, species of fish in a total of protected surface area of 9.9% [20]. In the territory of Serbia, the number of protected species is small in the 6.5% of protected territory, and for Montenegro there are no data on the protected species (tab. 6) [21].

Conclusions

In order to assess the status of the environment in the WBC region, five aspects of environment were observed: air, water, waste, soil, and biodiversity. The analysis of available data, produced several conclusions:

– the available data often are not comparable for the entire territory of WBC because the years when the status was recorded are different,
– data presentation methods are not uniform,
– some parameters in certain countries of the region were not tracked,
– there is a serious problem of the waste, especially of hazardous waste, in the entire region,
– as a small percentage of the surfaces are protected, and the quantities of waste are high, in most of the countries of the region, the soil degradation degree is very high, and
– even though it is known that as a result of high consumption of fertilizers, protective chemicals, *etc*., the groundwater is polluted, there are no complete data on the status of the groundwater in the region.

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