

Full Length Research Paper

Policies on population, development and pollution of the Black Sea basin

D. Ş. Beyazlı*, Z. Y. Bayram and Ş. Aydemir

Department of Urban and Regional Planning, Faculty of Architecture, Karadeniz Technical University, Trabzon, Turkey.

Accepted 10 May, 2010

The Black Sea is a closed basin which is connected to Aegean Sea through Bosphorus and Dardanel Straits: The basin is encircled with six countries from which major rivers Danube, Dniester, Dnieper, Yeşilirmak, Kizilirmak and Sakarya run through to the sea, which carry and discharge pollution from industrial, agricultural and domestic sources to Black Sea Basin that grows cumulatively. They discharge into virtually enclosed Black Sea on the wastes of a combined population of 165 m people in 17 countries. Sewage washes up on the beaches, spreading disease and making the shores unsafe for residents and tourists. Pesticides and fertilizers are often over-applied and run into the rivers. The dimensions of pollution come from rivers in to Black Sea Basin, and impacts of that on human settlements and the environment in the basin and Integrated Coastal Zone Management (ICZM) and Strategic Action Plan are the main concern of this paper, which will be evaluated with the data available. 150 million ton solid matters carried by erosion in to Black Sea, 17% of that came from Turkey. 75% of land based pollution came from Danube, 20% from independent states of former Union of Soviet Socialist Republics and 5% came from rivers of Turkey and Bulgaria.

Key words: Black Sea basin, river basin, pollution, hot point, heavy metal.

INTRODUCTION

Black Sea basin's features

The Black Sea is a natural inland water basin situated between Europe and Asia which is connected to Aegean Sea through Bosphorus and Dardanelle Straits: The basin is encircled with six countries (Figure 1); Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine. The lengths of their respective coastlines are: Bulgaria-354 km, Georgia-310 km, Romania-225 km, Russia-800 km (including the Azov Sea), Turkey-1329 km and Ukraine-2782 km (including the population of about 16 million people that inhabits the coastal zones of the six countries. Some of the major cities and ports are situated on and at the mouth of the rivers that play very important roles in economies of those countries (Figure 2) (URL-1).The major rivers of BSEC countries are Danube, Dniester, Dnieper, Yeşilirmak, Kizilirmak and Sakarya run through to the sea, which carry and discharge pollution from Industrial, agricultural and domestic sources to

Black Sea Basin, growing cumulatively. Main characteristics of those rivers are shown in Table 1. They discharge into the virtually enclosed Black Sea the wastes of a combined population of 165 million people in 17 countries (Figure 2). Figure 2 and Table 1 arranged from those countries statistics.

The state of the Black Sea environment

The legal framework for regional cooperation was elaborated after the 1972 Stockholm Conference on Environment and Development. In the early 1990s, representatives of the six Black Sea countries drafted their own Convention for the Protection of the Black Sea against Pollution, signed in Bucharest in 1992 and ratified by the six national assemblies by early 1994. The Bucharest Convention includes a general framework of agreement and three specific protocols: on the control of land-based sources of pollution, on the dumping of waste and on joint action in the case of accidents, such as oil

*Corresponding author E-mail: dilekbeyazli@gmail.com.

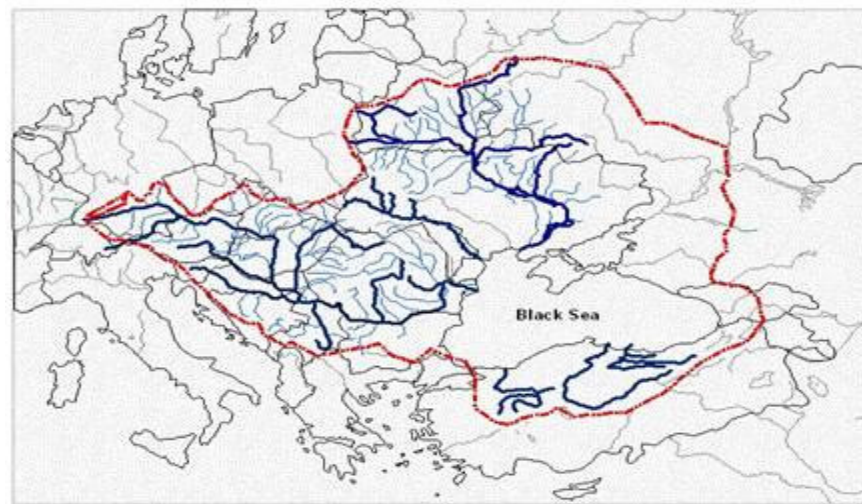


Figure 1. Shows in the river basin of the Black Sea Economic Cooperation (BSEC) Rivers

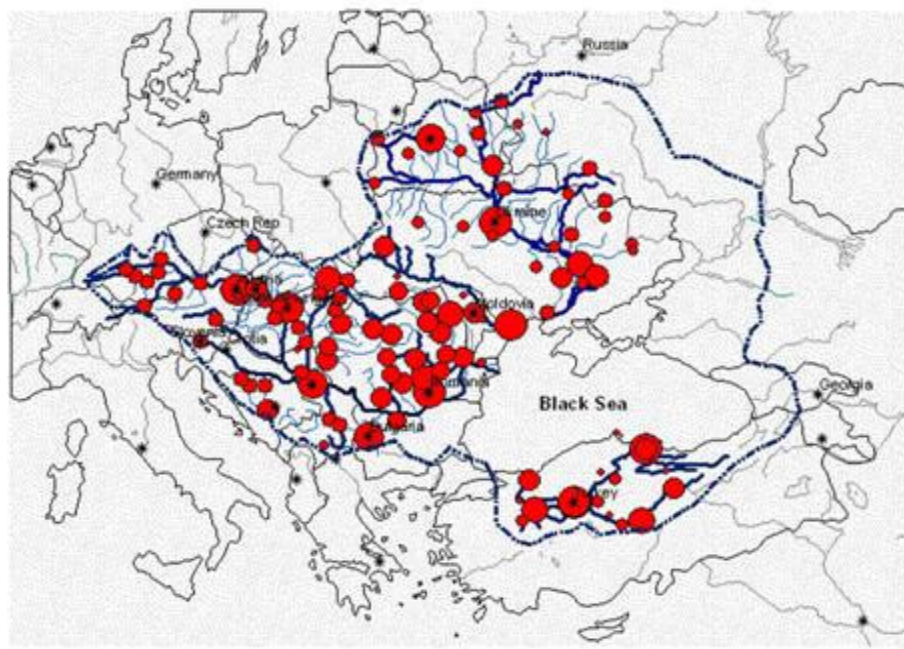




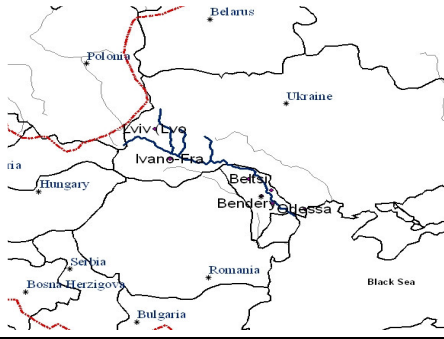
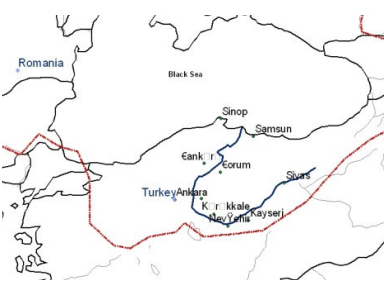


Figure 2. Population distribution: Black Sea basin cities.

spills. The implementation of the convention is overseen by a commission with a permanent secretariat based in Istanbul, hence, the Istanbul Commission (URL-1).

Another important step in the regional process was the ministerial declaration on the protection of the Black Sea Environment, signed by the six environmental ministers in Odessa in 1993. Shortly after, the countries requested support to develop a long-term Action Plan (URL-1). "The

Transboundary Diagnostic Analysis (TDA), which is a technical annex to Strategic Action Plan, leads to the following conclusions (URL -3): The Black Sea ecosystem continues to be threatened by inputs of certain pollutants, notably nutrients. Nutrients enter the Black Sea from land based sources, and in particular through rivers. The Danube river accounts for well over half of the nutrient input to the Black Sea (Table 2).

Table 1. Some characteristics of the BSEC River (Kibaroğlu et al., 2005; URL-2).

Danube					
Lenght	2.780 km				
Area	801.463 km ²				
Catcment basin pop. ¹	73.3 million				
Discharge	6.500m ³ /sn (229.545cu ft/s)				
Sub-Basin	Lech, In, Morava, Roab/Raba, Vah, Ipel/Ipoly, Drava and Mura, Tisza (Somes/Szamos, Mures/Maros), Sava, Velika Marava, Timok, Siret, Prut				
Lake in the basin	Lake Iron Gates I, Lake Iron Gates II, Lake Neusiedl				
Dinyeper		Dniester			
Lenght	2.200 km	Lenght	1.362 km		
Catchment basin pop	13.1 million	Catchment basin pop	3.1 million		
Area	504.000 km ²	Area	72.100 km ²		
Discharge	1.670 m ³ /s (52.7km ³ /a)	Discharge	10.7 billion m ³ - 8.6 billion m ³ - 6.6 billion m ³		
Sub-Basin	Prityat, Elancik, Mius	Sub-Basin	Yahorlyk, Kuchurhan		
					
Kızılırmak		Yeşilırmak	Sakarya		
Lenght	1151 km	Leight	519 km	Lenght	790 km
Area	77.100 km ²	Area	36,114	Area	65.000 km ²
Discharge	184 m ³ /sn	Discharge	5.80	Discharge	6.40(BCM)4
Catchment	7.1 million	Catchment	3 million	Catchment	5.8 million
Basin pop ²		Basin pop		Basin pop	
					

¹ 2001 populations² 2007 populations BCM: billion cubic meters

Table 2. Input of nutrient chemicals from the river entering into the northwestern part of Black Sea (all valuea in parts million⁻¹) (Zaitsev, 1992).

	Danube		Dnestr		Dnepr	
	1950	1986	1950	1986	1950	1986
Organic substance	2000	9800	100	246	250	664
Phosphates	13.00	50.00	0.14	1.00	0.80	4.00
Nitrates	97	238	2	13	55	89

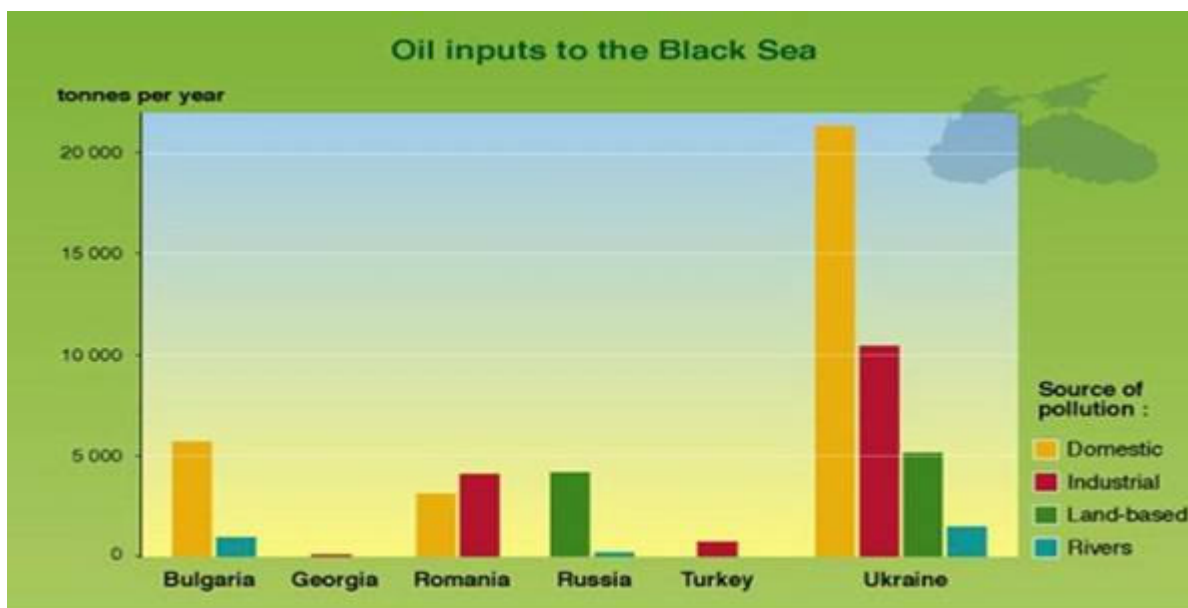


Figure 3. Oil inputs to the Black Sea (URL-4).

Eutrophication is a phenomenon which occurs over wide areas of the Black Sea and should be of concern to the countries of the Black Sea basin. Sewage washes up on the beaches, spreading disease and making the shores unsafe for residents and tourists. Pesticides and fertilizers are often over-applied and run into the rivers.

Inputs of insufficiently treated sewage result in the presence of microbiological contaminants, which constitute a threat to public health and in some cases, pose a barrier to the development of sustainable tourism and aquaculture.

In addition, inputs of other harmful substances, and especially oil, continue to threaten the Black Sea ecosystem. Oil enters the environment as a result of accidental and operational discharges from vessels, as well as through land based sources (Figures 3 - 4). Almost half of the inputs of oil from land based activities are brought to the Black Sea via the Danube river. Share of oil pollution of Danube approximately 87%. Ukraine pollutes mostly The Black Sea by domestic, industrial, land base and river pollution.

Moreover, the introduction of exotic species, through the deballasting of vessels, has been seriously damaging

the Black Sea ecosystem and constitutes a threat to the adjacent Mediterranean and Caspian Seas (URL-3).

The challenge which the region now faces is to secure a healthy Black Sea environment at a time when economic recovery and further development are also being pursued. Strategic Action Plan which is a step in the process towards attaining sustainable development in the Black Sea region. Its overall aims are to enable the population of the Black Sea region to enjoy a healthy living environment in both urban and rural areas, and to attain a biologically diverse Black Sea ecosystem with viable natural populations of higher organisms, including marine mammals and sturgeons, and which will support livelihoods based on sustainable activities such as fishing, aquaculture and tourism in all Black Sea countries (URL-3).

Toxic substances such as pesticides and heavy metals do not appear to pollute the whole sea but appear in 'hot spots' near certain well-identified sources. These polluters are usually associated with heavy industry and with the economic decline in the region their use has decreased considerably (URL-1) (Figure 5). Solid household wastes (worn-out car batteries, broken glass,

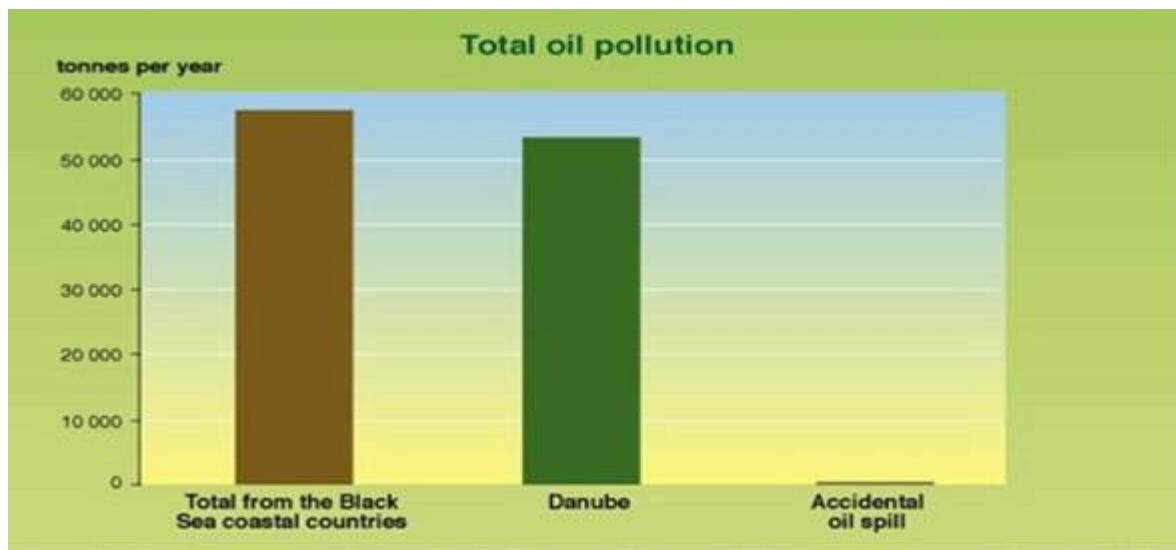


Figure 4. Total oil pollution (URL-4).



Figure 5. Major polluter settlements in the BSEC (URL-4).

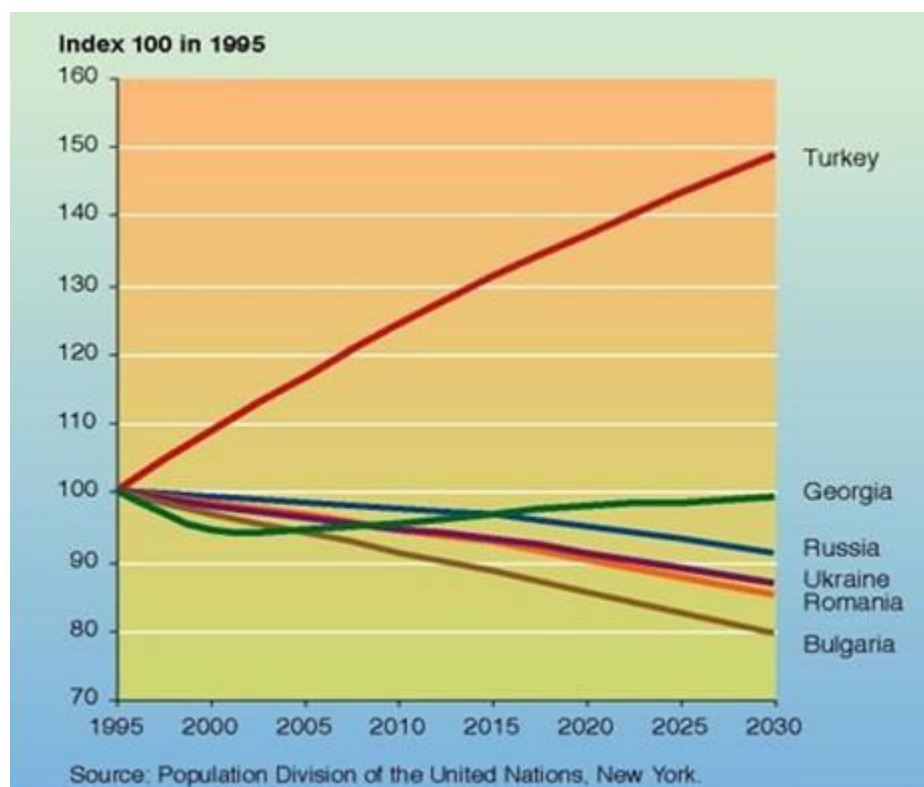


Figure 6. Population growth projections in the Black Sea region until 2030 (URL-4).

remains of paint, tin cans with lead-containing solder, etc.) are significant environment of hazards.

Population dynamic of Black Sea basin countries

Population potential of The Black Sea Countries gradually declining accepts Turkey as seen Figure 6.

Environmental management codes and rules should force nations to treat their household and industrial pollutions on sites and recycling plants. On the other hand people may use more industrialized food products which will decrease in the amount and volume of household wastes. On the other hand European Union (EU) population's packed and canned foods; consequently total amount of household pollution will decrease gradually. However Turkey may demand raw and processed foods and foodstuffs for some time. So, the amount of household pollution such as garbage will grow at a certain rate.

AN OVERVIEW: RESULT AND DISCUSSION

Environmental issues on the protection and rehabilitation of the Black Sea are of great concern for the coastal population. The sea has been used for fishing, tourism, mineral extraction and marine transport and as a

convenient dumping place for solid and liquid waste. The large influence of the land pollution and the intensive use of the sea by shipping dangers marine life. It is also clear that pollution is the result of the human activities in all coastal countries and if the crisis is to be averted, the issue has to be addressed jointly by the six countries (URL-1).

150 million ton solid matters carried by erosion in to Black Sea, 17% of that came from Turkey. 75% of land based pollution came from Danube, 20% from independent states of former Union of Soviet Socialist Republics and 5% came from rivers of Turkey and Bulgaria (URL-5).

Beside river pollutions, pollution by ships brings some 45,000 tons of oil into the Black Sea every year, says the World Bank. Many ships discharge their ballast and during loading and unloading because many Black Sea ports lack of reception facilities (Land, 1999). Since then pollution may increased due to carrying some part of Asian oil over Black Sea. The concluding results are arranged from most polluting river; Danube, Dnieper, Dniester, Kiziliriak, Yeşilirmak and Sakarya.

Pollution carried by Danube in to the Black Sea basin

Danube River is the most important pollution carrying source which born from Eastern Germany, passes almost



Figure 7. Significant point source of pollution in Danube river basin (URL-5).

11 central European countries having about 120 tributaries and merges to Black Sea at Lacul Hazeln over Constance of Romania. The basin's population is about 80 million. Danube River has been carrying 11 million ton pollution in which the amount of nitrites increasing 6 times, phosphates 4 times since last 25 years (Table 2). Discharges from such plants significantly raise the levels of heavy metals and organic micro-pollutants in the river network (URL-5).

Danube carry one third of Europe's pollution itself to the Black Sea, passing through agricultural, industrial and densely populated settlements. The chemical, food, and pulp and paper industries are amongst the main industrial polluters in the Danube River Basin. In all, Danube Basin is estimated that there are 87 sources of polluter (Figure 7). Ranking of polluters by industry types and countries are given in Table 3. Unfortunately the authors could not reach similar data for Dniester and Dnieper Basins and Georgian and Turkish Black Sea River Basins.

Too much inadequately treated waste water still ends up in the Danube, putting at risk the drinking water supply for millions of people, and also leading to problems for irrigation, industry, fishing, and tourism.

Toxic substances are also a major threat, made worse by occasional industrial accidents or floods when deadly toxins may be flushed directly into watercourses.

1. Excessive nutrient loads (particularly nitrogen and phosphorous)
2. Over exploitation of surface water and ground water resources
3. Changes in river flow patterns (hydro morphological alterations) and its effect on sediment transportation
4. Contamination with hazardous substances (including heavy metals, oil, oxygen depleting substances and microbiological toxins)
5. Accidental pollution
6. Degradation and loss of wetlands (URL-5).

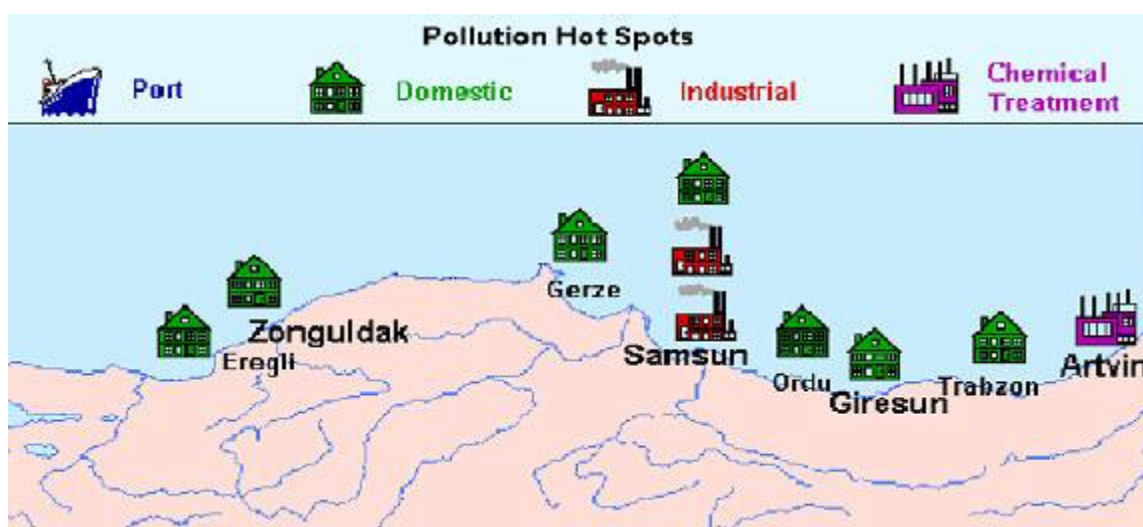
The immediate environmental impacts include water pollution, ground water and soil contamination, the reduced availability of clean water. Other longer-term impacts can include the depletion of natural resources, landscape degradation, reductions in biodiversity, and health risks.

Pollution carried by Dnieper and Dniester in to the Black Sea basin

Total population of the Dniester Basin within Ukraine and Moldova is 13 million; over 5 million live in Ukraine and 2.74 million in Moldova. Dnieper River Basin's

Table 3. Ranking of pollutants by industry type in Danube Basin (URL-6)

Industry type	Rank	% distribution
Chemicals	1	21.8
Pulp and paper	2	19.5
Food industry	3	18.3
Other relevant industries	4	12.6
Iron and steel	5	9.2
Leather industry	6	6.9
Mining	7	4.6
Fertilizer	8	3.4
Metal surface	8	3.4

**Figure 8.** Pollutions Hot Spots in Black Sea Region of Turkey (URL-8)

population is 3 million (URL-7).

All river basins such as Dnieper and Dniester in Ukraine were classified as polluted or much polluted, but small tributaries are more polluted than the main bodies.

Pollution carried by Sakarya, Kizilirmak and Yeşilirmak in to the Black Sea basin

Three rivers with total catchment areas of more than 50000 km² drain into the Black Sea through: Yeşilirmak, Kızilirmak and Sakarya. Çoruh River also drain to the Black Sea passing border to Georgia. Other rivers reaching the Black Sea through Turkey are short, torrential streams originating from the northern face of the mountains (Condé et al., 2002).

In the Black Sea Region of Turkey, nut and tea processing plant, various food manufactures, fishing products are the main industry types. On the other hand, coal mining, fertilizer factories and copper mining, melting and processing facilities are important industries (Final

Project Report, 1997). The two important iron and steel factories of Turkey are in the Western Black Sea region. On the other hand, the eastern Black Sea Region has minor industrial activities, such as hazelnut facilities, flour mills and fish-oil plants (Altaş and Büyükgüngör, 2007) the major pollutants by industry, waste and locations are given in Figure 8 and Table 4, which are carried by the above rivers. A study which “Heavy Metal Pollution in the Black Sea” showed that “The main sources of Hg, Cu, Pb, Cd and Zn in the Eastern Black Sea are the effluent discharged from the Copper Refinery in Hopa and the mouth of Harşit Stream in Tirebolu-Giresun. In addition, important amount of copper and lead and a remarkable amount of mercury and cadmium reach the Eastern Black Sea trough the Kizilirmak and Yeşilirmak Rivers and Pazar Stream” (Ünsal et al., 1998) (Table 5).

Another problem of major general concern is the discharge of insufficiently treated sewage, which results in the presence of microbiological contaminants. Such discharges constitute a threat to public health and in some cases pose a barrier to the development of

Table 4. The major Turkish industries and their type of waste in the black sea region (Bakan and Büyükgörgör, 2000).

Type of industry	Probable pollutants and characteristics of effluents	Location
Food manufacturing	BOD, COD, suspended, chemical and organic materials, odor, specific pollutants from each type of manufacturing such as sugar and slaughtering	Giresun, Ordu, Samsun, Sinop, Sakarya, Trabzon, Zonguldak
Manufacture of pulp and paper	pH change, high amount of suspended, colloidal and dissolved materials, cellulose	Giresun, Zonguldak
Manufacture of non-metallic mineral product	Heated cooling water, suspended solids, inorganic salts	Ordu, Samsun, Trabzon
Manufacture of wood and cork products	Organics from staining and sealing wood products	Ordu, Sakarya
Non-ferrous metal basic industries	Acid, metals, toxic, low volume, mainly mineral matter	Samsun, Trabzon
Manufacture of industrial chemicals	Acids, mineral elements, suspended solids, caustic, phenols, formaldehyde	Samsun, Sakarya
Manufacture of textile	Highly alkaline, colored, high BOD, temperature and suspended solids	Samsun, Zonguldak
Beverage industries	BOD, suspended and precipitable solid materials, fat and oil	Giresun, Ordu, Trabzon
Tea plant factories	Wastes of tea leaves	Rize, Artvin, Trabzon, Giresun
Cigarettes	Wastes from tobacco and its treatment	Samsun, Sinop, Trabzon
Coal mining	SiO ₂ , CaCO ₃ , Al ₂ O ₃ , Co, Cd, Li in coal ash	Zonguldak
Hazelnut	Suspended material	Trabzon, Ordu, Giresun

Table 5. Hydrochemical characteristics of Rivers merging to the Black Sea (Bahçekapılı, 2008).

Rivers	NO ₂	NO ₃	NH ₄	P	Cd	Cu	Db	Zn
Danube	238			50000			4500	12000
Dniester	13			100				
Dnieper	89			4000				
Sakarya	220	180000	49000	430	112	70000	2400	110100
Filyos	128	13900	550	1200	241	139800	4400	155600
Kizilirmak	67	7600	5840	270	300	31100	8500	231000
Yeşilirmak	185	25600	2900	3000	190	11100	5800	186900
Melet	5.7	1800	540	93	240	1500	440	50600
Aksu	23	4000	970	320	74	2300	1600	36800
Değirmendere	16	1700	81	2700	150	19800	460	93000
Melet Çayı	79	3200	710	300	130	7100	3300	40600

sustainable tourism and aquaculture. In the Black Sea coastal region, waste from approximately 10,385,000 people goes into sewerage systems. They discharge an estimated 571,175,000 m³/year into the Black Sea or into downstream stretches of rivers and from there to the sea. Some Black Sea countries are trying to improve waste treatment but many of the existing treatment plants are not working properly.

Oil pollution continues to threaten Black Sea coastal ecosystems. Currently levels of oil pollution are not high in the open Black Sea but are unacceptable in many coastal areas and river mouths. Oil enters the environ-

ment as a result of accidental and operational discharges from vessels, as well as through land based sources. According to Black Sea scientists, every year about 30,000 tons of oil enters the sea from domestic sewage plants, 15,500 tons from industry (including the oil industry), and 53,000 tons flows down the Danube River. Other toxic substances such as pesticides and heavy metals do not appear to pollute the entire Black Sea but appear as "hot spots" near well-identified sources. Heavy metals, such as cadmium, copper, chromium and lead, are usually associated with waste from heavy industry and the ash remaining from burning coal for generating

electricity. Pesticides are mostly introduced through rivers and streams discharging from agriculture. However, as a result of economic decline the use of these substances has decreased considerably and no longer presents a major hazard in the sea, except where their use was very intensive in the past.

Conclusion

Black Sea Countries' population is increasing steadily, though production of industrial and chemical materials increasing higher than the population causing different kinds of pollution. This situation raises increasing concerns between EU and Black Sea Countries to protect marine environment from further pollution. For this those countries devised an action plan to protect Black Sea which will facilitate better use of resorts, marine environment and benefit from.

REFERENCES

- Altas L, Büyükgüngör H (2007). Heavy Metal Pollution in the Black Sea Shore and Offshore of Turkey: Environmental Geology- International J. Geosci., 52-1-6: 469-476.
- Bahçekapılı A (2008). Karadeniz ve Çevre. http://www.karalahana.com/karadeniz/bati_karadeniz_cevre.htm, accessed: 20.04.2008.
- Bakan G, Büyükgüngör H (2000). The Black Sea: Marine Pollut. Bull., 41: 4-43.
- Condé S, Richard D, Liamine N, Leclère A S, Sotolargo B, Pinborg U (2002). European Environment Agency; Europe's biodiversity; Biogeographical regions in Europe; The Black Sea Region. EEA Report No 1/2002. http://www.eea.europa.eu/publications/report_2002_0524_154909/biogeographical-regions-in-europe/blackseareg.pdf, accessed: 20.08.2008.
- Final Project Report (1997) GEF National Protection and Management Routine Pollution Monitoring Project about the Monitoring of Land-Based Pollutants, Bathing Water and Drinking Water Quality. Prepared by Research Center of Environment in Ondokuz Mayıs University, (Project Leader Büyükgüngör, H.), Samsun, Turkey
- Land T (1999). Pollution and Politics in the Black Sea: Contemporary Rev., 374-1600: 230-236.
- Kıbaroğlu A, Klaphake A, Kramer A, Scheumann W, Carius A (2005). Cooperation on Turkey's Transboundary Waters. Status Report commissioned by the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety, F+E Project No. 903 19 226.
- Ünsal M, Çağatay N, Bekiroğlu Y, Kıratlı N, Alemdağ N, Aktaş M, Sarı E (1998). TUBITAK Project (YDEBÇAG-456/G-457/G), Heavy Metal Pollution in the Black Sea. <http://www.yunus.sumae.gov.tr/-2005/04/16.pdf>, accessed: 13.04.2008.
- Zaitzev Yu P (1992). Ecological Status of the Ukrainian Zone of the Black Sea Shelf: a Survey: Gidrobiologicheskii Zhurnal. (in Russian; English translation: Hydrobiol. J., 29: 4-22). 28: 3-18.
- URL-1. The Black Sea Non-Governmental Organization Network (BSNN) Web Site. Commitment to the Black Sea. http://bseanetwork.org/Black_sea.htm, accessed: 17.05.2008.
- URL-2. United Nations Economic Commission for Europe (UNECE) Web Site. Drainage Basin of The Black Sea. <http://www.unece.org/env/water/blanks/assessment/black.pdf>, accessed: 17.05.2008.
- URL-3. Black Sea Web Project Web Site. Strategic Action Plan for the Rehabilitation and Protection of the Black Sea. <http://www.blackseaweb.net/action/content.htm>.
- URL-4. United Nations Environment Programme (UNEP), GRID-Arendal Web Site. <http://www.grida.no>, accessed: 14.05.2008.
- URL-5. International Commission for the Protection of the Danube River (ICPDR) Web Site. <http://www.icpdr.org>.
- URL-6. The ICPDR Roof Report for Danube River Basin 2004 Web Site. <http://www.defyu.org.yu/Download/Danubeandus-broshure.pdf>.
- URL-7. Cooperation in The Transboundary Dniester River Basin Web Site. Transboundary Dniester River Project. <http://www.dniester.org/about-the-region.html>.
- URL-8. Black Sea Environmental Internet Node Web Site. United Nations Environment Programme DEWA/GRID-Europe. <http://www.grid.unep.ch/bsein/tda/files/3a32em.htm>.