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Sustainable development and environmental risks in Estonia

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Abstract. Sustainability in Estonia is based not only on natural resources and environmental restrictions, but also on the nation`s culture, spiritual traditions and ethnic values. Nearly 40 significant environmental problems are identified in the National Environmental Strategy. A serious problem is past pollution caused by industrial, agricultural and military activity of the former Soviet Union. To date past pollution dangerous to human health is liquidated and thoroughly monitored in most areas and sites.

Key words: sustainable development, environmental risks, past pollution, environmental cleanup, groundwater pollution, radiation level

INTRODUCTION

An appeal of the XXI century is sustainable development foreseeing the dynamic conception of economic and social development with the chances for a more equal division of resources between the states and their more efficient use within the states. The precondition for its implementation is democratic reform, the aim of which is to promote public participation in the decision-making process and which presumes that both consumption in developed countries and population in developing countries would be considered together with the levels of ecological tolerance.

At the Rio Conference in 1992, in which I had the honour to participate, an old-time slogan was promoted: “Think globally, act locally”. The Estonian approach to sustainability is based not only on natural resources and environmental restrictions, but also on the nation’s culture, spiritual traditions and ethnic values, which, along with education and the legislation framework, will create a new lifestyle (Ratas & Raukas, 1997). It means a better quality of life as well as an ecologically secure living environment. In 1995, the Act of Sustainable Development was adopted in the Parliament of the Republic of Estonia, second in the world after Costa Rica. Several local “Agendas 21” were prepared and most local governments have been active in integrating the principles of sustainable development in their planning activities. Implementation of the environmental objectives is based on the reforms of instruments and institutions of environmental management, which include technical, administrative, economic and institutional measures.

At a state level, the priorities for sustainable development are as follows (Ratas & Raukas, 1997): to protect the environment and human health; to conserve energy; to prohibit directly harmful substances; to ensure better life quality for the society; to support the activities of NGOs related to environmental protection; intellectual and physical development; to support the national price policy, biodynamic agriculture and less polluting transport; the use of natural non-polluting materials and recycling of waste; to promote a healthy lifestyle, tourism and hiking; to promote public awareness, to improve education of all population groups in sanitary and hygiene issues.

On March 12, 1997, the Estonian Parliament approved the National Environmental Strategy (Estonian…, 1997). Nearly 40 significant environmental problems were identified while analysing the state of the environment and the use of natural resources. The most important aspect underlying prioritisation of environmental problems was the maintenance of human health. The environment affects human health primarily via polluted air, water and contaminated soil. Therefore, among ten priority environmental problems, past pollution caused by industrial, agricultural, and military activities of the former Soviet Union was mentioned. Similar problems are also included in a new environmental strategy (up to 2030) approved in Parliament on February 14, 2007 (Eesti…, 2008) and in the National Environmental Action Plan of Estonia for 2007–2013 (National…, 2008), approved by the Government of the Republic on February 22, 2007.

MATERIALS AND METHODS

The origin of pollution and pollution load on soils and groundwater differ. The principal factors causing soil pollution in Estonia include the following: pollutants leached out of oil-shale ash hills; pollutants leached out as a result of phosphorite processing; pollutants washed out of thermal power plants and basins and oil-shale processing plant waste depositories, spillage of oil products and missile fuels at former Soviet military bases; fuel storage and landfills established without any consideration of environmental requirements; pollution from former primitive asphalt pavement plants; waste dumping by industrial enterprises; abandoned toxic chemicals in former storage areas for pesticides and poisonous substances; illegal dumping of waste, including municipal and hazardous waste; oil pollution on main railway junctions.

In most cases, the chemicals used in agriculture do not behave as pollutants for soils. Some of them (nitrates) will not accumulate in the soil; others (phosphates, heavy metals) form relatively stable complexes. Contamination of soils with fuels and other oil products is usually a local phenomenon.

According to the Decree of the Minister of the Environment of October 25, 1993 the past pollution is thoroughly monitored through the environmental monitoring system, consisting of state, county and municipal levels. Environmental damage caused by the Soviet occupation is generalized in a special monograph (Raukas, ed., 2006). The results of state monitoring and thematic investigations constitute a basis for political decisions undertaken by the government.

RESULTS AND DISCUSSION

The main environmental risks and influences for society in Estonia are s*eismic shocks,* causing rock falls on the klint and damages to houses, r*ecent tectonical movements,* which, in meridionally-oriented big lakes (Peipsi and Võrtsjärv), had led to the submergence of vast areas and several settlements, f*lood hazards in nearshore* *towns (Pärnu, Haapsalu), landslides in river valleys, and slope erosion in hilly topography, coastal erosion and ice push, wind erosion and karst subsidence.* Most dangerous risks are connected to mining and chemical industry regions and ex-military areas of the former Soviet Union (figure).

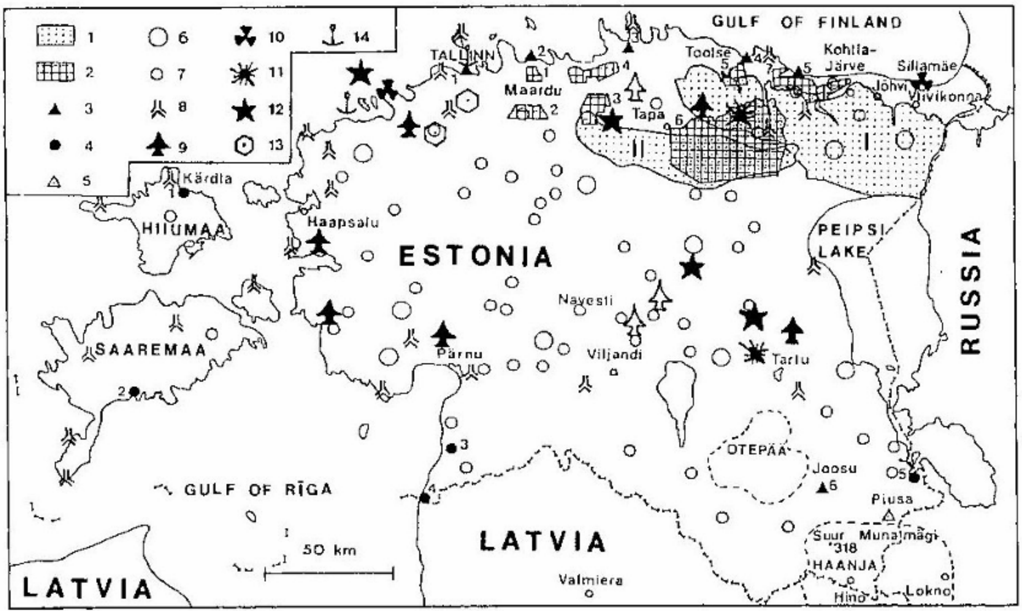

Figure 1. Main environmental risks in Estonia. **A – Mining of mineral resources:** (1) Oil shale: I – Estonian Deposit; II – Tapa Deposit; (2) Phosphorite: 1 – Maardu; 2 – Raasiku; 3 – Kehra; 4 – Tsitre; 5 – Toolse; 6 – Rakvere; 7 – Aseri; (3) Clay: 1 – Kopli; 2 – Kallavere; 3 – Kolgaküla; 4 – Kunda; 5 – Aseri; 6 – Joosu; (4) Mineral Water: 1 – Kärdla; 2 – Kuressaare; 3 – Häädemeeste; 4 – Ikla; 5 – Värska; (5) Sand for glass (Piusa); (6) Peat in bogs more than 10,000 ha; (7) Peat in bogs 2000–10,000 ha. **B – Former Military objects*:*** (8) Missile bases; (9) – airfields; (10) radioactivity; (11) explosives; (12) training areas; (13) tanks; (14) military ports.

Mining activities as a big factor of pollution

Estonia is rather rich in mineral resources, the mining of which has caused severe environmental damage. Estonian phosphorite deposits are the largest in Europe, and reserves of limestone, dolostone and clay are practically unlimited. Bogs cover 22.3% of the territory wih the max thickness of peat 16.7 m. Since the 1960s, Estonia has been the greatest oil shale producer and consumer in the world; by March 2006 a billion tons of oil shale had been produced. Serious problems are connected with large losses of oil shale during mining and enrichment (more than 30%) and voluminous dewatering. After mining and benefication, much limestone remains unused and is deposited in waste dumps. Alkaline ash, which also has to be deposited, remains near power stations. The majority of toxic waste (semicoke) comes from the oil shale chemical industry. The power stations using oil shale emit large amounts of carbon dioxide and other gases. Fly-ash deposition has resulted in an increase in the accumulation rates of several microelements in soils and lake sediments and a decrease in the organic matter content in lakes.

Alum shale (up to 60 billion tons) is rich in uranium and other (Mo, V, Th, Re a.o.) valuable microelements. During the opencast mining of phosphorite at Maardu in the neighbourhood of Tallinn, alum shale rich in uranium (average 80–120 g t^{-1}, maximum 300–450 g t^{-1}) was deposited in waste dumps. Waste hills at Maardu contain 73 million tons of alum shale: several million kg of uranium will leach into surface and ground waters and will reach the Gulf of Finland. Environmental effects in the mining sector and the resulting hazards were greatest in the 1980s, but now the situation is improving.

Pollution in ex-military areas

Russian troops withdrew from Estonia on August 31, 1994, however, the damage and pollution this army left behind will remain for many years to come. Based on the results of the systematic inventory started at the end of 1992, the clean-up costs of the damage caused by the Soviet Army to the environment in Estonia are estimated at 60 billion Estonian kroons, i.e. more than 5 billion USD.

There were 1565 military objects of the former Soviet Union in Estonia which occupied a total of 87,000 hectares, i.e. 1,9% of the territory of Estonia (Raukas, 1999). Their concentration was the highest in Harju County, where 564 units occupied an area of 48,040 hectares. The largest area (more than 30,000 ha) in the possession of occupational troops was the artillery range at Aegviidu. Other sites occupying large areas were the military airfields at Tapa (771 ha), Tartu (682 ha), Pärnu (731 ha), Ämari (930 ha) and Haapsalu (799 ha) and the missile bases at Karujärve (1218 ha), Sõrve (1647 ha), Sänna (543 ha), Kadila (941 ha) and Keila-Joa (480 ha). Almost all the sites once occupied by the military units of the former Soviet Union and Russia were heavily contaminated.

The airfields, particularly their fuel storage facilities, posed the greatest threat to the environment. For instance, so much fuel was dumped into the ground at the military airfield at Tapa that the soil and water in the town were almost completely polluted. Ground water was unfit for drinking in an area of about 16 km^2 and a free petrol layer has been established in an area over 6 km^2. In some drill holes the free petrol layer was more than 5 m thick. The amount of free oil under the surface was estimated at 400–1600 tons.

A very serious problem relates to the pollution of soil and ground water by samine, a toxic alkaline component of liquid rocket fuel, which consists of about 50% triethylamine and 48% xylidine. The spill of 10–15 tons of samine at the missile base at Keila-Joa, west of Tallinn, has contaminated an area of 32 hectares.

As the army departed, it left behind a large amount of waste, including scrap metal, tyres, accumulators, plastic waste, debris, etc. The low-quality construction far away from central settlements cannot be used for civil purposes and must be pulled down.

The former Soviet Army possessed large artillery ranges, where bombing, artillery shooting and infantry exercises were practiced. About 65,000 hectares of Estonia's forests remained within the boundaries of artillery ranges and tankodromes (at Männiku near Tallinn, at Klooga, etc.). These were mishandled and subjected to purposeless destruction. Large areas of wooded land were destroyed in fires caused by shooting and bombing. In many cases these were the most picturesque areas, for instance, the esker and kame topography near Aegviidu. Direct acts of warfire in the large artillery ranges caused much damage to the environment. For instance, 1000 hectares of land was turned upside-down by the bombing funnels on Pakri Island, at the Aegviidu artillery and bombing range more than 6000 hectares of land were damaged by bombs and fire, killing a huge number of flora and fauna. The artillery ranges at Aegviidu, Utsali, Männiku, Klooga and Keila abound in trenches, craters and bombing funnels. Mines, shells and unexploded bombs have been found in great quantities at almost all artillery ranges. Abundant excavations in the rocket bases and liaision units have changed the landscape beyond recognition (dugouts, artificial hillocks. etc.).

The problems related to the now defunct Soviet factories and other enterprises were much the same. Some towns (Paldiski, Sillamäe), harboring secret enterprises, were closed not only to foreigners but also to the local population. The best example is the town of Sillamäe, where after the discovery of uranium in Estonian alum shale, the production of uranium concentrate (and afterwards several other rare elements on the basis of imported raw material) was undertaken (Nosov, 1995). In total, more than 4 million tons of uranium ore were processed at the plant from 1948 to 1977. The production technology and data on waste were kept top secret.

Pollution load on groundwater

As a result of extensive economic activities, and the combination of high vulnerability of the uppermost aquifer and a thin aeration zone (mainly 1,5–3 m), the shallow groundwater is heavily polluted and unfit for drinking in some places. In 1990 the groundwater did not meet the requirements established for drinking water in 40–70% of the total number of shallow wells (depth to 15m) in southern, 20–40% in northern, 30–60% in central Estonia and in 10% of wells on the islands of the West-Estonian Archipelago (Põllumajanduslik…, 1997). In the regions of agricultural activity, nitrogen compounds are the primary contaminant of groundwater, but the concentration of chlorides and sulphates is also rather high. As a result of the dewatering of oil-shale mines, the groundwater level of Quaternary and Ordovician aquifers has lowered by 15–65 metres and several cones of depression have formed in large areas.

Radiation level

The radiation level in the environment has been monitored in Estonia since the beginning of the 1960s; the results were secret or meant for limited official use only. The content of radioactive minerals in Estonian basement and bedrock is variable. The highest concentrations of uranium are connected to Lower Ordovician alum shales (*Dictyonema* argillites). High radon risk exists in the outcrops of alum shales. In 1994, the national radon monitoring programme was initiated by the Ministry of Environment; the dangerous locations have been mapped and indoor radon measured in risk areas.

CONCLUSIONS

Overall, environmental policy reforms in Estonia have been successful. The former high pollution loads, for the most part, have been liquidated and thoroughly monitored. For example, the biochemical oxygen demand from Tallinn treatment works declined from 100 milligrams per litre in 1991 to 4 milligrams per litre in 1998. Dust emissions from Kunda Cement Plant dropped more than 99% during the 1990s and by the decade`s end, sulphur dioxide emissions from Kehra Pulp and Paper Mill were reduced by more than 90% over 1991 levels. Coupled with the toxic mess left by the Soviet Army units Estonia confronted the most expensive environmental cleanup task of the newly independent Baltic States. Now the direct danger is over (Auer & Raukas, 2002). At present, however, growing disparities between urbanites and agrarians exist and much must be done to provide environmental services in small rural towns and hamlets.

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