

# Waste management in Larissa prefecture, Greece

S. Bakopoulou<sup>1</sup> & A. Kungolos<sup>2</sup>

<sup>1</sup>*Department of Management of Rural Environment and Natural Resources, University of Thessaly, Greece*

<sup>2</sup>*Department of Planning and Regional Development, University of Thessaly, Greece*

## Abstract

It is the objective of this study to evaluate the management of air waste, wastewater and solid waste in the prefecture of Larissa, Greece. The levels of air pollution in the prefecture are not so high. Nevertheless, examination has showed that the existent atmospheric pollution is mainly attributed to static sources, such as central heating and industry, especially in the city of Larissa. The study of water pollution includes surface and underground water. The surface water pollution is mainly attributed to industrial wastewater. The pollution of Pineios River is characterized by fluctuations. In some areas of the river, especially after the city of Larissa, the levels of pollution are high. Moreover, the waters of Asmaki canal and Karla Lake are so polluted that there is no possibility of finding life in these water bodies. On the other hand, the groundwater pollution is related to the high concentration of nitrates, caused by over-fertilization of farming lands. Sources of soil pollution include domestic solid waste landfills and especially uncontrolled landfills in many areas of the prefecture. The main problem is that some of these landfills are located near rivers or streams, provoking essential pollution. This evidence has showed that one program about the optimal waste management has to be developed in the prefecture in order to protect the renewable natural resources according to the principles of sustainable development.

*Keywords: Larissa prefecture, waste management, air pollution, water pollution, soil pollution, wastewater treatment plants, nitrates, uncontrolled solid waste landfill sites, pollutant emissions.*



## 1 Introduction

In the post-war period and particularly during the last two decades, the environmental dimension was considered as an integral part of development policy, which attains, in this way, a qualitative character. The *new dogma* is, now, the securing of development sustainability, which is based on the fundamental ecological principles of solidarity between generations, resource renewal etc [1]. In other words, long-term ecological sustainability involves protection and restoration of critical ecological components, functions and structures in perpetuity, so that future, as well as, current generations can have their needs met [2]. The new sustainability policy uses a variety of implementation instruments, such as economic instruments or environmental thresholds.

The main achievement of an environmental study regarding sustainable development in an area is that it may provide an important role model to citizens and other community institutions of environmentally responsible behaviour. In large prefecture corporations, the “greening” of the workplace can be effectively promoted by establishing environmental management systems and guidelines for each department. This fact addresses the specific mandates and procedures of those departments. The establishment of such a project includes several parameters like policy integration and inter-sectional approach, self-commitment of the prefecture to the principle of sustainable development, attainment of several environmental economic and social goals, minimization of produced waste and procurement of environmentally friendly goods and services [3].

Taking in mind the main philosophy of sustainable development, this paper aims at presenting the problems related to waste management in Larissa prefecture and suggesting optimum solutions in order to minimize environmental hazards. It is essential to realize that an integrated management is desirable.

There have been in Larissa prefecture quite some studies regarding specific environmental issues, such as air pollution [4], industrial wastewater pollution [5] or soil pollution [6]. On the other hand, there has not been a paper presenting all these issues in an integrated way at regional level. The authors of this study believe that our findings could be used as a base for strategic environmental planning in the target area.

## 2 Environmental conditions in the target area

Prefecture of Larissa is situated in the central eastern part of Greece, in the region of Thessaly (Figure 1). The population of the prefecture in 2001 reached up to 279305 inhabitants within an area of 5381 km<sup>2</sup> (51.9 inhabitants/km<sup>2</sup>). This is an area with a significant percentage of cultivable land (42%) while the rest covers mountainous and semi-mountainous areas.





Figure 1: Situation of Larissa prefecture in Greece.

Larissa is the capital of the prefecture with a population of 126076 inhabitants and it is situated in the centre of the prefecture (Figure 2).



Figure 2: Situation of the city of Larissa in the prefecture.

The main environmental problems that characterize the area of Larissa include air, water and soil pollution and are further analyzed in the following paragraphs. Information and data for this study were gathered from official documents written by state, internal notations and scientific literature.

## 2.1 Air pollution

The atmospheric environment is mainly influenced by human activities especially near the city of Larissa. Generally the levels of air pollution near the city are not so high. Nevertheless, examination has showed that in specific periods of the year the levels of the existent atmospheric pollution are higher than the standards that the legislation sets. The concentrations of  $\text{SO}_2$  from November till March reach up to  $200 \mu\text{g}/\text{m}^3$ , while the standard set by WHO is



125  $\mu\text{g}/\text{m}^3$ . On the other hand, the concentrations of  $\text{O}_3$  from May till August fluctuate from 100 to 180  $\mu\text{g}/\text{m}^3$  while the limit is 150  $\mu\text{g}/\text{m}^3$  [7].

Specific data has showed that these levels of atmospheric pollution are mainly attributed to static sources, such as central heating and industry, especially in the city of Larissa. Pollutant measurements that were carried out by the Greek Ministry for the Environment, Spatial Planning and Public Works (YPEHODE) and concern central heating have showed that the concentrations of specific pollutants such as  $\text{CO}$ ,  $\text{NO}_x$ ,  $\text{C}_x\text{H}_y$  are over the standards set by the European model EN 303-2 [4]. This means that the majority of the existent central heating units in the city of Larissa do not function according to the principles set by the qualified authorities. However, it is believed that the recent usage of natural gas in central heating may improve the situation.

The industrial activities around the city of Larissa considerably influence the atmospheric environment and mainly the concentration of  $\text{CH}_4$ . According to specific data, gathered from YPEHODE, the  $\text{CH}_4$  quantity emitted in the prefecture of Larissa corresponds to 84% of all methane emitted in Thessaly region [4].

The contribution of traffic to atmospheric pollution is also quite significant. The increasing number of vehicles in Larissa urban areas influences mainly the concentration of photochemical pollutants. The traffic problems are aggravated by the increasing demand for parking services, which has become one of the main sources of traffic condition worsening, especially in the city center and the eastern part of Larissa, where the main motorway of the country is also situated. Recently, a new bypass of the motorway was constructed and now it is used. This fact has contributed to the improvement of environmental conditions in the area. Nevertheless, we find encouraging the fact that 62% of the inhabitants of the city move on foot or by bicycle in the center of the city.

Regarding existent measuring systems, it should be noted that there are no systematic controls of air quality in the city by local authorities. These controls assume the using of modern technology (on line measuring systems, etc.). One measuring system has been installed in the center of the city since 1986, but the measurements of  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}$ ,  $\text{NO}_2$ ,  $\text{O}_3$  are not enough to evaluate the air quality of the city [7].

## 2.2 Water pollution

Examination of the surface water in the prefecture contains the examination of Pineios River, Asmaki canal and Karla lake waters. The levels of pollution in Pineios River are characterized by fluctuations. In summer period and in some areas, especially after the city of Larissa, the levels of pollution are very high. There are systematic controls of the Pineios River water quality with measurements of TOC, nitrates, ammonia and dissolved oxygen. Temperature, pH and suspended solids are also systematically measured. Findings have showed that in the area between the sugar industry and the Tempi valley the quality of the water is not so good, especially in summer period. This bad situation is mainly attributed to industrial wastewater (Figure 3) and secondly to pollutants such as nitrate and ammonia derived from cultivable lands. The main



industrial activity that provokes essential pollution is related to sugar industry, metal industries, vegetable industries and mainly alcohol industries [5].

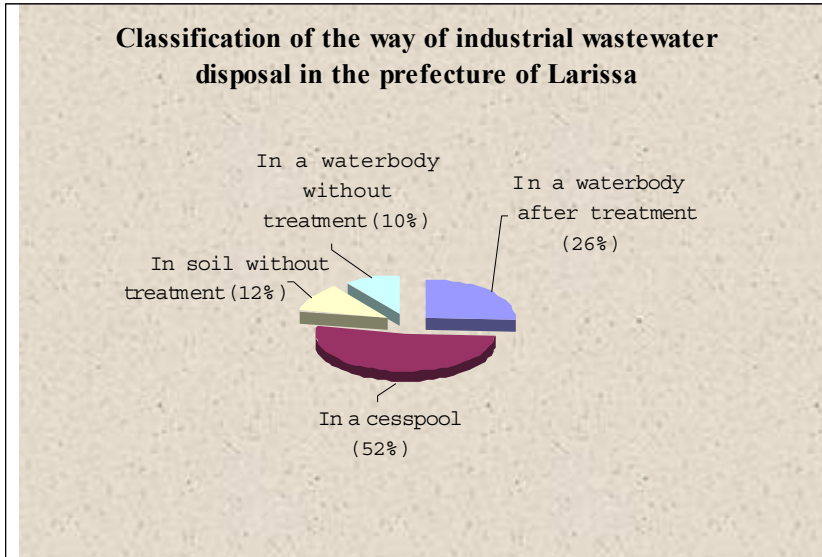


Figure 3: Industrial wastewater disposal in Larissa prefecture.

Municipal wastewaters from the city of Larissa do not seem to contribute in a large scale to the Pineios river pollution. The operation of Larissa wastewater treatment plant since 1989 has contributed for many years to the reduction of the high pollution levels of Pineios River that had been noticed before. The plant now receives wastewaters produced by 115000 residents reaching up to 19600 m<sup>3</sup>/d, while in 2005 the treatment capacity will reach up to 39200 m<sup>3</sup>/d. The industrial wastewaters that are not disposed in water or soil without treatment (Figure 3) are not carried in this wastewater treatment plant, but in specialized treatment systems in the industrial area of Larissa or in each industry separately [8]. There are wastewater treatment plants in the cities of Tirmabos, Giannouli and Ellassona, as well. It is worth mentioning that a physical treatment system operates in Sarantaporo village. In all other villages wastewaters are disposed in the soil by absorbent cesspools or septic reservoirs, and pollutants may be transferred in underground waters.

The alcohol industry wastewaters are also responsible for the pollution of Asmaki canal and Karla Lake. In these water bodies the water quality keeps on deteriorating. Many industries that are situated near the north exit of Larissa city, especially alcohol industries and paper industry, dispose their wastewaters in Asmaki canal and from this to Karla Lake. Because of the low flow of the Asmaki canal, any wastewater disposal could provoke essential pollution. The result is that the levels of pollution that characterize these water bodies are so high that there is no possibility of finding life in them. Water quality monitoring



in Asmaki canal and Karla Lake has not been very effective [9]. Moreover, the draining program that was put into practice in the lake of Karla in 1960s had as a consequence large quantities of water to be enriched in nutrients components. The last ones were correlated to the important agricultural activity of the area.

Moreover, in the greater area of Larissa city, as well as Farsala city, intensive agriculture of cereals and cotton is applied by using significant quantities of fertilizers containing high percentages of nitrogen, phosphate and sulphur. The result is that significant quantities of nitrates contaminate the groundwater of the area. Data has showed that the groundwater nitrate pollution in the area between the cities of Larissa and Farsala is too high. In 1993 in the majority of the villages in this area the nitrate concentration in the groundwater was over the standard set by legislation. It is referred, as an example, that in N. Leuki village the nitrate concentration of the drinkable groundwater reached up to 150 mg/L, while the standard is 50 mg/L [10]. More recent measurements, which were carried out from 1999 till 2000 both by the Greek National Institute for Agricultural Survey (ETHIAGE) and the Institute for Geological and Mining Surveys (IGME), have showed that the average nitrate concentration of the groundwater in the area between Larissa and Farsala reached up to 40.5 mg/L. It is worth mentioning that in 25% of the cases that had been examined, the nitrate concentration exceeded the limit of 50 mg/L [11]. The reduction of the nitrate concentration levels in groundwater was attributed to the implementation of one program by the Greek Ministry for Agriculture, which had as a goal the reduction of fertilizers usage in the farming lands of the prefecture.

### 2.3 Soil pollution

Sources of soil pollution include domestic and industrial solid waste landfills and especially uncontrolled landfills that are under operation all over the prefecture. The majority (66%) of the solid wastes produced in the prefecture consist of agricultural products that cannot be sold anymore and wastes from cattle-breeding activity. It is easily understood that the uncontrolled disposal of these wastes, which are characterized by high levels of BOD<sub>5</sub>, could be responsible for the appearance of significant pollution problems, especially in the soil, groundwater and surface water. Other solid wastes include domestic ones (17%), industrial ones (16%) and sludge from the operating wastewater treatment plants (1%) [6].

In the prefecture of Larissa, there is a sanitary landfill that has been under operation since 1998 and it is located at the area of Maurolithos, 25 km northwestern from Larissa city. In this landfill about 60000 ton of domestic solid wastes are disposed each year coming from municipality of Larissa, few municipalities around the area of Maurolithos and many industries. The total area of the landfill reaches up to 560000 m<sup>2</sup>, from which the 200000 m<sup>2</sup> are used for the solid wastes disposal [12]. It operates according to the latest technology.

The disposal of all the other solid wastes produced in the prefecture is been made in uncontrolled landfill sites. Data has showed that 51 uncontrolled landfills are under operation now in the prefecture [6]. The main problem is that some of the wild landfills are located close to rivers or streams provoking



essential pollution. There are uncontrolled landfills next to rivers (i.e. uncontrolled landfill of Rodia village) (Figure 4) and other ones that are close to forest areas (i.e. uncontrolled landfill of Stomio village). The operation of the latter ones is a potential cause of fires in nearby forests.



Figure 4: Uncontrolled landfill next to Titarisios River.

The recycling of solid wastes is not common in the prefecture. Nevertheless, there are some industries located in the city of Larissa, which buy the recycled solid wastes. Specific components of domestic solid wastes, such as paper and metal materials, are selected in special buckets in the city of Larissa and are carried for recycling [13]. The municipality of Larissa constructed recently one recycling plant in the area of the sanitary landfill, so that the maximum possible quantity of solid wastes could be recycled. In this way, the final solid waste quantity that should be lead to the landfill is reduced.

One other problem related to agriculture, contributes also to the soil pollution of the prefecture. Phenomena, such as erosion, are mainly attributed to the over terrace cultivation in many areas of the prefecture [11].

### 3 Conclusions and suggestions

In this study, the environmental quality of Larissa prefecture was examined, resulting in the following conclusions:

Regarding the air quality, the operation of central heating and industry results in the deterioration of the atmospheric environment. The emissions of these static sources represent the main factors that contribute to the atmospheric pollution of the prefecture. The establishment of a modern on-line gas emissions measurement system is required for the continuous monitoring of pollutants. Furthermore, this system should be combined with a system of mobile instruments for the measurement of specific pollutants in specific areas of the city. A management plan which aims at the spreading of the use of environmentally friendly energy sources, such as biomass and natural gas,

should be developed. It should be referred that natural gas has been used in many buildings in Larissa city for purposes like heating. However, the above-mentioned management plan should aim at widening its usage in state buildings. This management plan should also include the renewable energy sources, such as solar and wind energy that could be exploited in many areas of the prefecture (i.e. Karitsa village). Furthermore, one plan about the broadening of bicycle use in the city of Larissa should also be developed by constructing special bicycle roads. Cycling is an important way of overcoming many problems relating to traffic.

Water pollution problems in the target area are mainly associated to industrial wastewaters, not so much to municipal ones, and undoubtedly to increased nutrient content of water receivers. Despite the fact that a measurement system on Pineios River is already on line, a water quality monitoring program is considered as necessary, especially in Asmaki Canal and Karla Lake. This system should include an extended network of on line instruments for the continuous measurement of water parameters in certain locations. The measurements should also include the performance of bioassays for the evaluation of toxicity in an ecosystem, which will be coupled with the chemical analysis results. Moreover, the construction of infrastructure related to municipal and industrial wastewater treatment plants is considered necessary. A management plan should be established in order to set priorities in the construction of them. Undoubtedly, priority is going to be given in municipalities or industries that are responsible for the pollution of Asmaki canal and Karla Lake and secondly to the other ones that may influence Pineios River. According to the Greek legislation, all the municipalities with population over 2000 residents should construct till 2005 municipal treatment plants. The number of such municipalities in Larissa prefecture reaches up to 15. It is also suggested to establish a continuous measurement system in specific areas, especially between Larissa and Farsala, regarding the groundwater pollution, which is related mainly to high nitrates concentration. The continuation of the program about the fertilizers reduction represents a crucial point, which should be paid attention to. Undoubtedly, this program should be accompanied with other ones, such as the implementation of multiple cultivations in the crucial areas during all year and imposition of measurements of soil quantity characteristics before any cultivation period. This program will have success, if it is established in addition to another one, which aims at the sustainable use of all available water sources in the prefecture.

Soil pollution in the prefecture is mainly attributed to the operation of uncontrolled landfill sites. One program about the restoration of these ones is of great importance in the prefecture. Priorities should also be set here with the restoration of these ones that are responsible for the most important pollution problems in the prefecture (i.e. uncontrolled landfills close to rivers, streams or forests). Special emphasis should be given on methods of solid wastes management, including the collection of municipal solid wastes and the extended application of recycling programs. The controlled sanitary landfill, which is under operation currently, has the opportunity of acceptance of the total





solid waste quantity, so there is no necessity of constructing another one in the prefecture. Important infrastructure, such as composting, should be developed in the area of the existing sanitary landfill in order to make the whole system more efficient.

In general an integrated system of environmental management in the area of Larissa prefecture has to be achieved through the commitment of responsibility both by local society and the responsible authorities. Only in this way, the desirable collaborative decision-making will be achieved in a process of environmental planning in any prefecture. A special agency, where municipalities, civilians and industries could participate, is an issue that has to be considered in a serious way by the qualified authorities.

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