REWETLAND

Widespread introduction of constructed wetlands
for a wastewater treatment of Agro Pontino

LIFE+08 ENV/IT/000406

U-SPACE SRL

ACTION 4.5

REPORT ON THE STATE OF THE ENVIRONMENT IN THE PONTINE PLAINS

Partner:

REPORT ON THE STATE OF THE ENVIRONMENT IN THE PONTINE PLAINS

[1] The “Report on the State of the Environment in the Pontine Plains” arises from the need to establish a general “knowledge framework” about the context in which Rewetland will operate, and to evaluate and define, through four thematic in-depth examinations, the conditions of the water resource and the legal and planning framework. Starting from the data and conclusions achieved by the partners, and illustrated in the four technical reports on the use and quality of waters, on the conditions of the coastal wetlands and on the existing spatial planning tools related to environmental policies, the Report on the State of the Environment intends to describe the state of the territory and its biodiversity, to define the main pressures on it, and express its qualities and criticalities in respect to water and soil, using a method already widely tested by the local Agenda21.

The quantity and quality of information existing on the Pontine Plains are relevant, updated and of good level. Indeed, many databases are available, coming from national sources (e.g. ISTAT) and local ones (e.g. the database of the Province of Latina). The historical documentation regarding the evolution of the plains, from the land reclamation to its agricultural and urban development, is rather rich, too, and also the scientific and environmental documentation is rich in information about the features of the area. Other very useful instruments are: the “General Provincial Territorial Plan” of the Province of Latina, accompanied by analyses and detailed studies on soils, land cover, springs and waters; the reports on the state of the environment written by the local Agenda21 of the municipalities of Latina, Sabaudia and Terracina; the Management Plan of the Circeo National Park.

The results of this wide analysis and the comparison among data shows the Pontine Plains as an environmentally rich area, complex but subject to great pressures. In fact, a great share of the project area is subject to environmental protection or constraints, but the rest of the area is composed of a wide agricultural matrix, crossed by the reclamation canals, which strongly characterises the local landscape. In these areas, the irrational urban development, the frequent unauthorised settlements and the progressive intensification and industrialisation of agriculture have caused a great loss of biodiversity. The conditions of environmental deterioration that can be found in many of the project areas can be defined critical, in particular as regards the pollution of the surface waters.

The polluted waters of the canals, used for irrigation purposes, worsen the general environmental quality, have a negative effect on the waste of the water resource, and – due to their low quality – push into the construction of

1 This document is a summary of the italian version.

new wells for drawing clean water. Moreover, flowing towards the coast, they cross the ecosystems of the protected areas (in particular the coastal lakes) and worsen the contamination of ground water.

The general picture shows that a wide-area environmental restoration programme for reducing the pollution of waters and wetlands, by removing the main pollution loads and controlling the pressures on the area, can no longer be postponed. A restoration of the functionality of the hydrographic network has to be considered as one of the main actions for restoring biodiversity, consistently with the landscape identity of the area. The increase in biodiversity, strictly connected to a process of environmental restoration, will be able to reduce the fragmentation of the Pontine territory in eological terms.

The content of the Report on the State of the Environment is to be considered the starting point for the Strategic Environmental Assessment of the Environmental Restoration Programme which is the objective of the Rewetland project. The collected data are the reference framework for the definition of the sustainable development objectives, and can highlight the environmental criticalities of the area, being therefore the "baseline scenario" for the Pontine Plains. The Report on the State of the Environment, and the specific in-depth studies made by the project partners, will be the necessary information support for identifying the priorities and the assessment and monitoring indicators. Moreover, the formalisation of the state of the art of the environment and the spatial planning activities in the "Agro Pontino" will ensure the correct setting of the objectives and methods for implementing the Rewetland pilot projects.

Environmental policies and Agenda21

In the Rewetland area, the most innovative instrument for the environmental protection is the Ecological Network of the Province of Latina, which has been set up in 2009 by the Province, thanks also to the funding of the Region of Latium.

The conservation objectives mainly regard the habitats of Community interest, the species of Community interest (vascular flora, terrestrial fauna and fauna of inland waters – Vertebrates, Crustaceans, Molluscs and Insects), and the endemic species or species included in the "Red List" of Italy and Latium.

Further important instruments of environmental protection, which are active in the Rewetland area, are connected to the Natura 2000 network (SCIs and SPAs) and to the local Agenda21 process. Following the 2008 Regional Deliberation concerning SPAs, two SPAs have been identified; they are part of the Natura 2000 network, regulated by the Ministerial Decree 17/10/2007 and by the Birds and Habitat Directives. These areas are IT 6040015 (Circeo National Park, 22,000 hectares), and IT 6030043 on the Lepini Mountains (more than 45,000 hectares).

For these areas, several environmental protection and biodiversity conservation measures are active, including check-lists of the animal species, databases on the distribution of species, studies on the vegetation, dissemination activities such as publications and scholarly and popular contributions.

Moreover, specific obligations and prohibitions have been introduced: in particular, the prohibition of land reclamation in the natural wetlands; the hunting ban concerning the protected species; the monitoring of the water level in the wetlands; the reduction of nitrates released into surface waters for agricultural activities; the long-term set aside for the arable land; the maintenance and environmentally-friendly cultivation of rice paddies; the promotion of organic farming methods; the creation and maintenance of vegetated buffer strips.

Other important measures for the protection of the environment are the creation of national and regional parks, nature reserves, natural monuments and protected wetlands, which, within the Rewetland area, cover more than thirty special protection areas.

Among these, the most relevant is certainly the Circeo National Park, for which a Management Plan has been implemented in 2010.

The local Agenda21 process has been implemented in the municipalities of Latina, Terracina and Sabaudia.

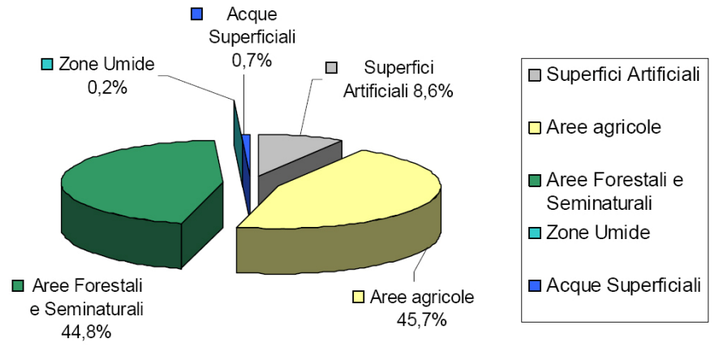

Figure 1 Percentages of land cover classes according to CORINE classification (*source: "La Rete Ecologica della Provinca di Latina", October 2009).*

Further seven relevant environmental studies, having been elaborated in the Rewetland area, are the following:

1. The ecological network of the Lepini-Ausoni-Aurunci mountains;
2. The ecological network of the Aurunci Mountains, Rio Santa Croce and Cape of Gianola, and the ecological network of the Circeo National Park and the Ausoni Mountains;
3. Monitoring of the origin of pollutants and state of eutrophication of the inland waters of the Province of Latina;
4. Atlas of the springs of the Province of Latina;
5. The soils of the Province of Latina: map, database and related applications;
6. Water collection and water resource in the Mazzocchio basin;
7. Land cover map.

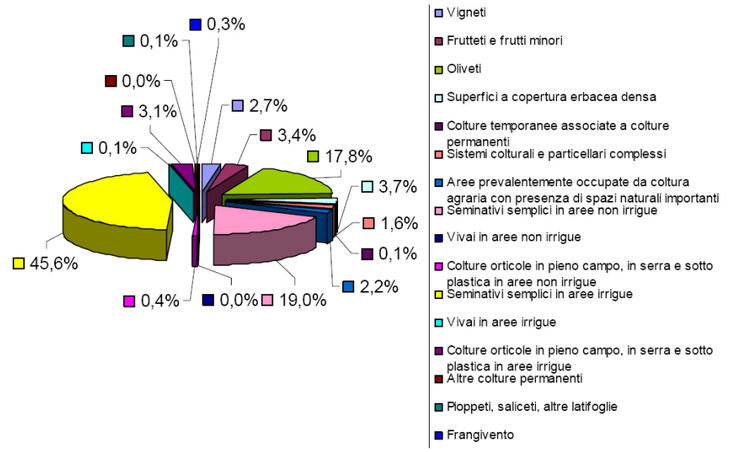

Figure 2 Percentages of land cover classes (3rd level of CORINE legend) within the category "Agricultural areas" (*source: "La Rete Ecologica della Provinca di Latina", October 2009).*

Soil and water quality

Land cover[2]

On the base of the studies carried out by the Province of Latina, which in 2009 has elaborated the Land Cover Map, it can be reported that the main land uses in the Province of Latina belong to two macro-categories: agricultural areas (45.7% of the area) and forest and seminatural areas (44.8% of the area). The other categories (artificial surfaces, surface waters and wetlands) cover less than 10% of the area. Indeed, the use of land in the Province is dependent to its peculiar geography: predominantly agricultural in the plains (Agro Pontino), and predominantly wooded and seminatural on the mountains.

The plains along the coast, and in particular the Agro Pontino, are therefore subject to an agricultural use, but this is also where the urban devel-

2 Source: Piemontese L., Perotto C., 2004. Carta della Copertura del Suolo. La Provincia di Latina. Gangemi Editore, Roma. Pp:32 + 1 CD-Rom.

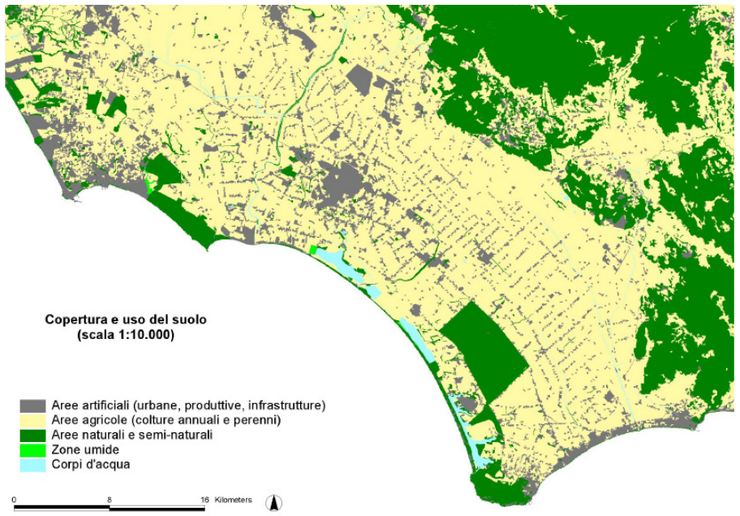

Figure 3 estratto dal DOCUMENTO PRELIMINARE DI PIANO - PArco del Circeo REgione Lazio, 2003. Carta dell'Uso del Suolo (CUS). Roma.

opment is more relevant, including road and railroad infrastructure and the industrial and commercial settlements.

Most of the agricultural land is permanently irrigated (45.6%); trees plantations are less frequent, among them the olive groves cover 17.7% of the land.

The Province of Latina has elaborated its own Land Cover Map, with a higher detailed compared to the regional one; this map is also viewable through the website of the Province. The map has been elaborated by the Planning Sector of the Province, and is to be considered a high-quality document to be used by local authorities and professionals as a technical support of their planning tasks.

Water quality

The evaluation of the quality of the Rewetland area has been carried out on the basis of the data reported by the Regional Plan for the Protection of Waters (PTAR), adopted through Deliberation of Regional Council n. 42 of Sept. 27, 2007. The plan, elaborated on the basis of data collected in 2001-2003, is currently undergoing a revision.

The evaluation of the water quality is expressed on the basis of the ecological and chemical status of the watercourses (Annex 1 of D.lgs. 152/99).

The ecological status is an expression of the complexity of the water ecosystems, of the physical and chemical nature of waters and sediments, of the characteristics of the water flow and the physical structure of the water body. The chemical status is expressed by the results of the chemical analyses on the water.

The Ecological State of the Watercourse (ESWC) is the result of the elaboration of two complementary indexes:

1. the Level of Pollution by Macro-descriptors (LPM), obtained by adding the scores related to 7 chemical and micro-biological parameters, considered in terms of 75th percentile of the series of measurements carried out;
2. the Extended Biotic Index (EBI), expressed as an average of the single values obtained throughout the year. Each section of the watercourse is assigned the lower of the values of the two indexes.

Table 1 Level of pollution expressed by the Macro-descriptors *(source: Relazione sulla qualità delle acque della Pianura Pontina. Progetto LIFE08/ENV/IT/000406, Azione 4.6. Provincia di Latina, July 2010).*

Parametro	Livello 1	Livello 2	Livello 3	Livello 4	Livello 5
100-OD (% sat.) (*)	≤ 10	≤ 20	≤ 30	≤ 50	> 50
BOD5 (O2 mg/L)	< 2,5	≤ 4	≤ 8	≤ 15 >	15
COD (O2 mg/L)	< 5	≤ 10	≤ 15	≤ 25	> 25
NH4 (N mg/L)	< 0,03	≤ 0,10	≤ 0,50	≤ 1,50	> 1,50
NO3 (N mg/L)	< 0,3	≤ 1,5	≤ 5,0	≤ 10,0	> 10,0
Fosforo totale (P mg/L)	< 0,07	≤ 0,15	≤ 0,30	≤ 0,60	> 0,60
Escherichia coli (UFC/100 mL)	< 100	≤ 1.000	≤ 5.000	≤ 20.000	> 20.000
Punteggio da attribuire per ogni parametro analizzato (75° percentile del periodo di rilevamento)	80	40	20	10	5
Livello di inquinamento dai macrodescrittori	**480-560**	**240-475**	**120-235**	**60-115**	**< 60**

Table 2 EBI values and quality classes *(source: Relazione sulla qualità delle acque della Pianura Pontina. Progetto LIFE08/ENV/IT/000406, Azione 4.6. Provincia di Latina, July 2010).*

Classe di qualità	Valore di I.B.E.	Giudizio di qualità	Colore tematico
I	10-11-12	Ambiente non inquinato	
II	8-9	Ambiente leggermente inquinato	
III	6-7	Ambiente inquinato	
IV	4-5	Ambiente moltoinquinato	
V	1-2-3	Ambiente fortemente inquinato	

Table 3 Ecological State of the Watercourse – lower value between Macro-descriptors and EBI *(source: Relazione sulla qualità delle acque della Pianura Pontina. Progetto LIFE08/ENV/IT/000406, Azione 4.6. Provincia di Latina, July 2010).*

	CLASSE 1	CLASSE 2	CLASSE 3	CLASSE 4	CLASSE 5
I.B.E.	≥ 10	8-9	6-7	4-5	1, 2, 3
Livello di Inquinamento Macrodescrittori	480-560	240-475	120-235	60-115	< 60

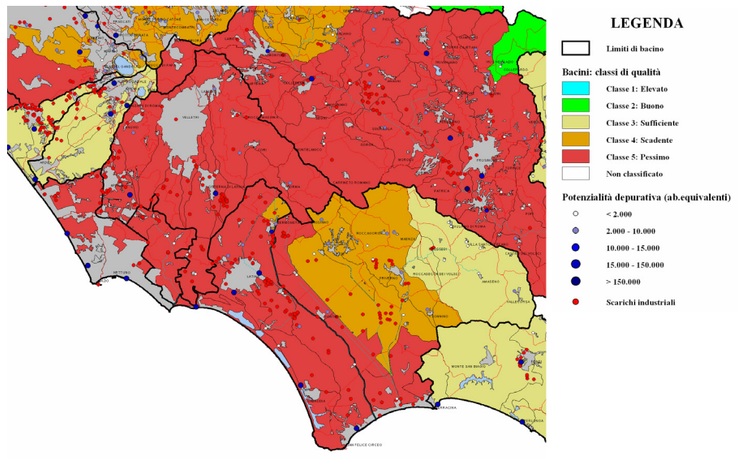

Figure 4 PTAR – Excerpt from the Regional Map of the State of Water Quality (partial legend).

For each monitored station, the PTAR reports the classification of the Ecological State (ESWC), but it has not been possible to carry out the classification of the Environmental State, because the data of the additional parameters for the minimum period of 24 months, as provided for by the D.Lgs. 152/99, were not available.

The information of the PTAR provides an alarming picture of the water quality in the Pontine Plain, where the main watercourses have an average ecological status ranging from poor to sufficient, as shown in Figure 4.

The PTAR data have been interpreted, under the objectives of the LIFE project, taking into account the distribution of the monitoring stations and the related water basins. The number and distribution of the stations don't allow for a sufficient detail enabling the programming of interventions, because the same station is often related to watercourses and water basins having very different characteristics and pollution values. In addition, the survey data refer to the period 2001-2003, therefore an update is necessary.

Figure 5 shows the monitoring stations that the PTAR refers to, and the related water basins. It can be noted that about a half of the minor water basins of the Pontine Plain, in the coastal sector, are not among the areas covered by the monitoring. The samplimg stations are placed along the main watercourses and are related to very wide water basins, in which there are rivers, ditches and canals of relevant importance.

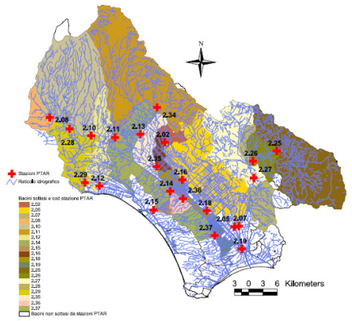

Figure 5 PTAR water quality sampling stations and related basins.

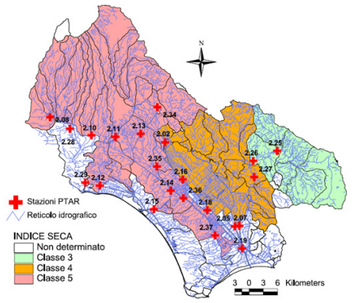

Figure 6 PTAR water quality sampling stations and ESWC index of the related sub-basins.

The water quality map as shown in Figure 6 is too generic and doesn't allow for planning specific interventions, caused both to the partiality of the information, and the lack of updated samplings.

Even in the case where the analyses made after 2003 were available, it would be necessary to multiply the samplings on the watercourses in order to obtain a more significant picture of the water quality, because the monitored areas are too heterogeneous, both from the hydrologic and the land use points of view. This is more evident if we look at Figure 4, showing the value of the ESWC index of the different sampling stations as an average characteristic of the related basins.

The flow rates of the watercourses and the related physical and chemical analyses have been carried out in two successive stages:

1. in the first stage (2003-2006) four sampling campaigns have been carried out on almost all watercourses having a perennial flow;
2. in the second stage (2006), 16 hydrometric stations have been installed on the main watercourses, and, starting from October 2009, bimonthly samplings have been carried out at the stations with physical and chemical analyses.

Hydrometric and piezometric measurement campaigns in the Province (2003-2006)

The river bed measurements (about 170 sections for each campaign) have entailed:

- the measurement of the water flow;
- the measurement of temperature, pH and specific electrical conductivity of the water;
- taking a sample of water for measuring the following parameters: dissolved oxygen, nitrates, phosphorus, chloride, hardness, and, in the last measurement campaign, ammonia.

The measurements in the wells (about 150 for each campaign) have entailed:

- the detection of the structural characteristics and the stratigraphy (when available);
- the measurement of the static level;
- the in-situ measurement of temperature, pH and specific electrical conductivity of the water;
- taking a sample of water for measuring the following parameters: dissolved oxygen, nitrates, phosphorus, chloride, hardness, and, in the last measurement campaign, ammonia.

As a first approximation, in the present report, the results of the river bed measurements have been elaborated in order to obtain an approximate state of the art of the quality of watercourses, by extracting the most critical values measured in the different campaigns, and discretised accoding to the following indexes:

Nitrati (NO3) (Indice 1)

Concentrazione massima rilevata (mg/l)	Indice numerico corrispondente
< 5	0
Tra 5 e 15	1
Tra 15 e 20	2
> 20	3

Fosforo totale (Indice 2)

Concentrazione massima rilevata (mg/l)	Indice numerico corrispondente
< 0,07	0
Tra 0,07 e 0,14	1
Tra 0,14 e 10	2
> 10	3

Ammoniaca (NH4) (Indice 3)

Concentrazione massima rilevata (mg/l)	Indice numerico corrispondente
< 0,04	0
Tra 0,04 e 1	1
Tra 1 e 15	2
> 15	3

Ossigeno disciolto (indice 4)

Concentrazione massima rilevata (mg/l)	Indice numerico corrispondente
> 7	0
Tra 5 e 7	1
Tra 3 e 5	2
< 3	3

Starting from the sum of the values of the four indexes, an overall index having a value between 0 and 12 has been calculated. In order to obtain a relative comparison among the different degrees of relative quality impairment of the different watercourses, the overall index has been arbitrarily divided into the following classes:

Classi di "compromissione" qualitativa relativa

Somma degli indici da 1 a 4	Indice di "compromissione" qualitativa relativa
0-3	basso
3-6	medio
6-9	alto
9-12	Molto alto

All the sections of the watercourses have been then grouped in classes which differ on the basis of the average flow rate, measured according to the following criterion:

Classi di portata

Portata media (l/s)	Classe di portata
0	1
0,1-5	2
2-25	3
25-100	4
100-500	5
500-1000	6
>1000	7

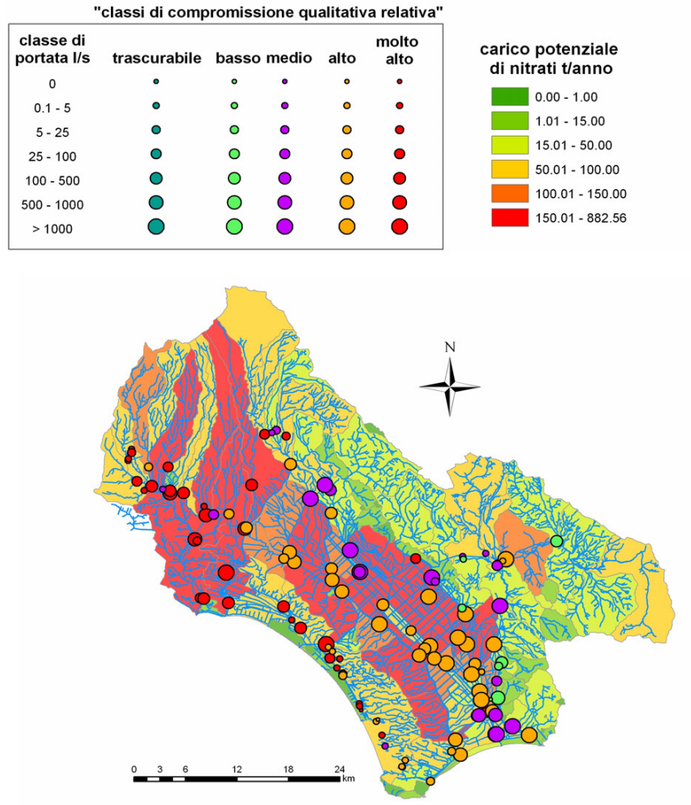

Figure 7 Comparison between nitrate loads potentially discharged into the sub-basins from diffuse and point sources, and classes of relative quality impairment calculated in the sampling stations of the different watercourses of the catchment areas of the Pontine Plain.

The information contained in the database of the water basins and sub-basins of the Province of Latina enables to evaluate the overall potential pollutant loads form point and diffuse sources.

Figure 7 shows the overall nitrate loads potentially produced in each sub-basin, compared to the index of quality impairment.

The analysis of data allows to obtain some significant indications:

- as already highlighted by the PTAR, the basins of the area of Albano (basins flowing into the Spaccasassi Canal, the Acque Alte Canal and the Astura River) have high levels of diffuse and point discharges, together with a high level of degradation of surface water quality;
- in the Pontine Plain, all basins have high values of pollution loads, the higher values being associated to the basins of the sectors with higher industrial concentration;
- the quality of the watercourses in the Plain is not always proportional to the quantity of potential loads of the catchment areas, because the higher flow rates, connected to the presence of important springs on the mountains, foster the dilution of pollutants.

What described here, even if referred to data being not always homogeneous and updated, can be considered indicative of the state of relative impairment of water quality at a sub-basin scale of detail. As already said, starting form October 2009, bimonthly campaigns of chemical and physical measurements are in progress, at the 16 hydrometric monitoring stations of the Province of Latina. The analysis of such data, and of the further updated environmental monitoring data provided by ARPA Lazio, will enable to define with more precision the state of the surface waters of the Rewetland area, as a function of pollutant loads of the different sub-basins, calculated also in relation to the runoff flows.

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