

## VALORIZATION AND AWARENESS OF THE TERRITORY THROUGH WASTEWATER TREATMENT PROCESS: THE PROJECT LIFE + REWETLAND – ABSTRACT

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### ABSTRACT

The paper is aimed to review the action carried out on different sites of the Agro-Pontino, implemented within the framework of LIFE+REWETLAND Project, trying to analyze the link between the exploitation of the territory through wastewater treatment processes and awareness of the same territory by the local citizens.

Within the paper, an analysis of the environmental and socio-economic drivers characterizing the surrounding context is provided. Subsequently, an examination of the pilot projects carried out in the different sites considered was implemented. Also, after trying to involve people in these activities, the contribution of Rewetland project towards the awareness of the territory has been studied.

Rewetland project has been crucial in order to understand the current complexity of the Pontine territory, from which all the implemented activities within the project have been defined.

Within the project, in addition to the construction of four phytoremediation pilot plants, a strategic planning document (*Environmental Renewal Programme*) has been developed.

This report sets out all of the measures that can be adopted in different sectors (urban, agricultural, industrial) and the dissemination and awareness activities that can be achieved, also through various web tools. The originality of the study consist to connect the activities in order to create an integrated system towards the awareness and the enhancement, by the local stakeholder, of the area of the province of Latina.

**Key words:** wastewater treatment processes, territory, exploitation, awareness.

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## 1. Introduction

In the context of wastewater treatment processes, the paper carries out an analysis of the actions implemented within the project LIFE + REWETLAND, which is aimed at valorize the Agro Pontino area through both water treatment processes and dissemination of awareness of the territory.

In recent years, much attention has been paid by decision makers on wastewater treatment through the development of a series of policies aimed at increasing the spatial scale of output and vertical integration, and to reduce the gap from the industrialized European countries. The processes of water reuse are considerable such as old and common practices, which, during the course of the years, were characterized by different development stages, knowledge of the processes, treatment technology, and regulation evolution (KAMIZOULIS G. ET AL, 2003). The first recovery processes of wastewater, with applied technology, began to be implemented already at the beginning of the previous century, despite wastewater reuse has been well known since ancient times, especially in the agricultural sector. The growing need for a reliable water supply has resulted in the development of wastewater reuse in different parts of the world. (URKIAGA A. ET AL, 2006). This necessity, due to the constant increase in the world population, has resulted in a gap between the supply and demand for water, which is reaching such alarming levels that in some parts of the world it is posing a threat to human existence.

Many studies are being developed to better conservation and reuse of water resources, in order to, for example, release clean water for use in other sectors that need fresh water and provide water to sectors that can utilize wastewater. The processes of wastewater treatment can be seen through a dual perspective: on the one hand have the problem of disposal, which is often faced by the municipalities, particularly in the case of large metropolitan areas with limited space for land based treatment and disposal; on the other hand wastewater can be considered as a resource applicable in different productive sectors, such as agriculture, aquaculture, and other activities (HUSSAIN I. ET AL, 2002).

Recognizing the strategic value of water resources for the economy and quality of life in Europe, Directive 2000/60/EC (DIRECTIVE WATERS, 2006) has established quality objectives for continental surface waters, which by 2015 the Member States will be achieved. Even though a recent report (EC, 2012), reveals that more than half of the nations is delayed on achieving these results, it is likely that in the future its compliance with the standards of the Directive will be an element of assessment of environmental quality of territories, which refers to the quality of goods and services produced there, such as agricultural products or the tourist services.

In Latina province, considering the agricultural and industrial production, the protection of quality and quantity of water resources is a key factor for socio-economic development. In fact, the compliance of local resource water to the quality standards set out by European legislation, means first and foremost to ensure the basic conditions for the consolidation and development of the high quality agricultural productions, which might otherwise see reduced their competitiveness.

The aim of the present paper, elaborated in the framework of the EU funded LIFE+REWETLAND Project, is to review of the implemented action on the different sites at Agro Pontino, trying to analyze the link between the exploitation of the territory through wastewater treatment processes and awareness of the same territory by the local citizens.

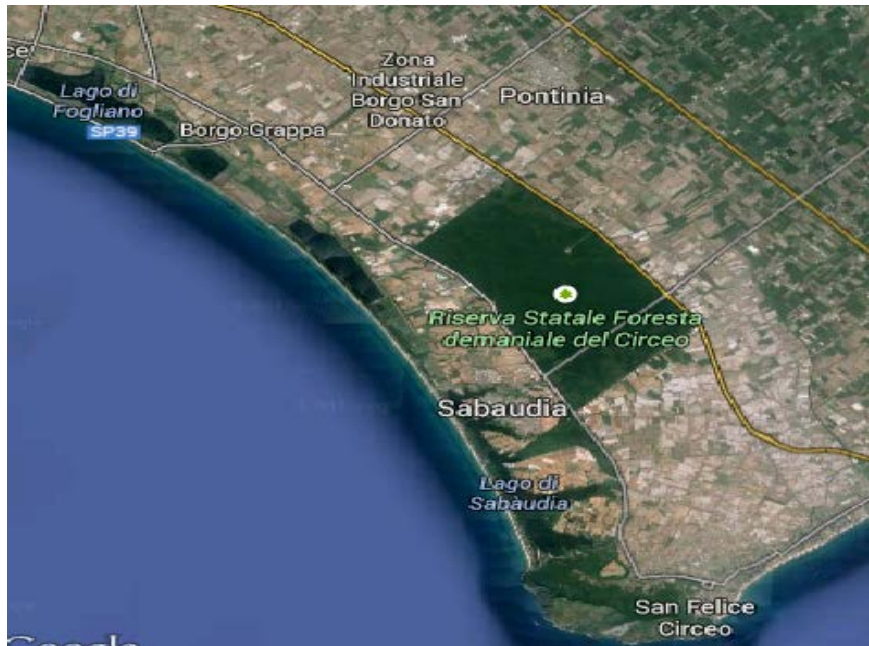
## 2. Agro Pontino: the frame of reference through an analysis of the environmental and socio-economic drivers

Agro-Pontine is an area that is born from the waters and that, for thousands of years, has remained such as a swampy area; over time has undergone a continuous evolution, which led to a partial loss of the rural character acquired with the reclamation, in favor of a modern structure of urban and industrial kind. Transformations that are beginning to show increasingly their limitations and the many issues related, in particular in relation to water quality, a resource that still continues to be crucial for the economy and developments of this area.

In the following paragraphs an analysis of the main environmental and socio-economic drivers will be provided, in order to better understand the territorial framework in which the activities of the *Rewetland* project are included.

### 2.1 Physiographical Characteristics

Agro-Pontine area is an extensive coastal plain of southern Lazio, ranging from the Lepini-Ausoni mountains to the Tyrrhenian Sea. Its boundaries are blurred in the northern part, but as the conventional limit is usually considered the middle and lower course of the Astura river.



The hydrographic network of Agro-Pontine has undergone profound changes over time, since the times of the Romans.

During the Fascism era were made a series of works that led to the formation of:

- ✓ A network of high water, including all streams coming from the surrounding mountains and that had sufficient slope to drain it spontaneously towards the sea, but that, before the reclamation, fueled essentially the marshes;
- ✓ A network of medium water, which collected water coming from internal territories of the plain located above sea level but whose outflow near the outfall was previously hampered by higher altitude of the surrounding areas;
- ✓ A network of shallow water, which concerned the lands who were at sea level or below it, and therefore needed a mechanical lifting device (dewatering pumps) in order to ensure the outflow of water.

The remediation actions above mentioned, along with many others made in that period, led to a radical modification of the territory, also causing the loss of most of its natural heterogeneity and, therefore, of its biodiversity.

## 2.2 Biodiversity and Protected Areas

The areas of great natural interest in this territory, can be essentially identified in the National Park of Circeo. The Park is of great importance in this area, not only from the naturalistic point of view, but also landscape and cultural. Despite is not much being extended, its characterized by a remarkable variety of ecosystems and, consequently, a significant wealth in terms of flora and fauna entities, some of which are at high risk of local extinction.

A particularly relevant environment, to the purpose of the project Rewetland, is the area in which are located the four coastal lakes of Fogliano, Monaci, Caprolace and Paola, who have been recognized such as wetland of international importance in according to the Ramsar Convention (1976)<sup>1</sup>.

In addition to the National Park of Circeo, in the Agro-Pontine area there are also other important natural areas that, although very small, appears to be important especially for the recovery of the ecological network function. Almost all

<sup>1</sup> Convention in which local decision makers committed themselves to promote the protection of wetlands and waterfowl in order to create natural reserves in these areas, ensuring an adequate surveillance and protection it over time.

of these areas, including the Circeo National Park, are recognized as nodes of the network Natura 2000<sup>2</sup>, namely Sites of Community Importance (SIC) and Special Protection Areas (ZPS) (<http://www.minambiente.it/pagina/sic-zsc-e-zps-italia>), respectively designated in accordance to the Directives 92/43/EEC (the Habitats ) and 2009/147/EC (formerly 79/409/EEC - Birds).

The rest of the Pontine plain has few or no natural relevances but, in many cases, it still retains a good potential for spontaneous recovery, which it would manifest more often if the anthropogenic pressures would decrease.

### 2.3 Socio-economic aspects

Despite the type of production that characterizes the Agro-Pontine area is still of agricultural type, the widespread urban development and the progressive agriculture industrialization have led to a noticeable alteration of the rural landscape. The hydraulic and sewerage restructuring, the immigration of people comes from North East and the build of new urban centers in the reclaimed area have led towards a big modification of administrative and social structure.

Today the population resident in the Pontine plain has exceeded 440,000 inhabitants, which would show a good level of attractiveness of the territory but at the same time, complaint an obvious increase of the pressure on the environment as a whole.

Such as for the most of Italy, also the economy of the Pontine plain has affected by the crisis of recent years, showing declines more or less relevant in different sectors. Agriculture, though largely entrusted to family-run farms, it is still a sector very profitable, not experiencing the phenomenon of the abandonment of the fields, thanks to targeted investments in terms of specialization.

As regards the secondary sector, the process of industrialization of the province of Latina began in the 50s with almost all processes related to the agricultural sector. Shortly thereafter the manufacturing industries have developed that over time have become very numerous. The sectors most represented were initially heavy engineering, agro-food industry, wood processing, chemicals and pharmaceuticals, textiles and some works related to construction. The abolition of the "*Cassa del Mezzogiorno*", and thus the end of the fiscal privileges that derived from them, has prompted many companies towards the closure, with the obvious socio-economic impact (LEPORE, 2011). The remaining large industrial plants, however, are numerous and are especially dedicated to the agro-food industry and chemical-pharmaceutical.

The service sector now occupies a large percentage of the labor force. Major investments were made recently in computer science and in scientific and technological research. Certainly not marginal is the tourism sector, which in recent years has been a booming, despite it is clear the seasonal demand gap between summer and winter season. Reducing this gap by increasing the attractiveness of the area between different periods of the year is one of the main objectives that the Pontine region is expected to reach in the future.

With the industrial development and of the economy, in general, comes an expansion of urbanization, with a steady increase of the settlements along the roadways and with the spread of edification within the farms. This phenomenon is briefly shown with the words "*sprawl town*" (INGERSOLL, 2004), namely the progressive spread of the city and its suburbs on the surrounding agricultural areas, which are transformed into low-density urban areas. Therefore, at the urban-rural dichotomy post-remediation has been replaced the urban sprawl, which is strongly characterized by a scattered residential settlement, where the agricultural land tends to be confused with that peri-urban (COPIZ R., 2014).

The integral reclamation, despite it being considered an epic undertaking, especially from the social and economic point of view, has produced many abrupt changes, leading towards a loss of identity which is still so much debated.

## 3. LIFE+REWETLAND Project

The Directive 2000/60/EC (Water Directive) establishes quality objectives for continental surface waters, which must be achieved by the Member States by 2015. Although a recent report (EC, 2012), reveals that more than half of the

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<sup>2</sup> Natura 2000 is the centrepiece of EU nature & biodiversity policy. It is an EUwide network of nature protection areas established under the 1992 [Habitats Directive](#). The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs) which they designate under the 1979 Birds Directive. Cfr. website: [http://ec.europa.eu/environment/nature/natura2000/index\\_en.htm](http://ec.europa.eu/environment/nature/natura2000/index_en.htm) (date of consultation: 09.07.2014 ).

nations are lagging about achieving of these results, it is likely that in the future its compliance with the standards of the Directive will be an element of evaluation of environmental quality of territories , to which associate the quality of generated goods and services, such as agricultural products or the tourist offer.

On the basis of these considerations, and considering the high levels of pollution from organic material and nitrogen compounds detected in the area, the province of Latina opted for naturalistic engineering actions, especially using techniques of phytoremediation.

It was presented, together with some regional partners (Municipality of Latina, Board of National Park of Circeo, Consortium of Reclamation of Agro Pontino and US-Space srl), a request for participation in the Program of the European Commission Life +08, which has been granted in 2009, initiating the *Rewetland* project in January 2010. The project was funded under the Environment sub-sector, Governance sector, just because the phytoremediation replicability and sustainability depends from the acceptance level of the local actors and from the ability by the institutions to manage this process.

Many experiences have shown that the solution of complex territorial issues is always an integrated exercise, to be pursued through the consent and approval of the territorial actors who then can facilitate or hinder it, decreeing the success or failure. The Integrated management, however, cannot operate without a structured system, thus requiring an inter-organizational setting, through which put in place an efficient strategy for the identification of the various stakeholders. The involvement of stakeholders appears to be the starting point for the implementation of the system. The level, and therefore the success of the exchange of ideas and approaches within interdepartmental working groups and cooperation between different areas of expertise, is the result of the involvement and communication level (BARILE, 2013).

The *Rewetland* project, therefore, represented an opportunity to begin a journey in this direction. In fact, the introduction of technical solutions of naturalistic profile towards the depuration problem, was developed through a participatory methodology, providing industry meetings and workshops with citizens and stakeholders about the issues.

This openness toward a state of consonance between actors (GOLINELLI, 2005) is an inescapable condition for transfer of technologies, especially when these are mostly good practices that need to be pursued by individual actors, with continuity, in a perspective of sustainable economic.

The *Rewetland* project intends to set up a wide-scale *Environmental Restoration Programme* in the “Agro Pontino”, an area with critical conditions of water pollution, mainly caused by an intensive agricultural activity. The objective of the project is to test and develop biological treatments for the reduction of pollutants coming from the agricultural activities, using solutions such as ecotone strips, filter ecosystems and artificial wetlands.

*Rewetland* intends to carry out interventions on the whole “Agro Pontino” (ca. 700 sq km), rather than on a single watercourse, taking into consideration the entire network of drainage channels (2200 km), therefore requiring a radical change in the maintenance techniques on the channels and, more in general, in territorial and landscape management.

The project is based, as previously described, on a participated management of the water system. The sharing of decisions with all stakeholders involved in territorial management (institutions, public and private bodies, farmers and citizens), and the inter-institutional collaboration among the bodies responsible for programming, planning and implementing the interventions, are deemed fundamental in order to ensure their effectiveness and achieve sustainability goals.

The project is based on two main demonstrative activities: the drafting of the *Environmental Restoration Programme* and the implementation of four pilot projects. It is composed by three main stages as follows:

- *Analysis*: explain the “framework of awareness” and implement a geographic database of the entire area; drafting of the feasibility studies about the pilot projects to be carried out in the second phase; drafting of a report on the state of the environment.
- *Planning, Negotiation, Participation*: achieve the *Environmental Restoration Programme*, comprising the participation process and the Strategic Environmental Assessment; implement the pilot projects:
  - ✓ buffer strips along the drainage channels;
  - ✓ linear natural park within an urban area of Latina;

- ✓ filter ecosystem in the Circeo Natural Park;
- ✓ interventions for the sustainable water management inside a farm.
- *Monitoring phase*: environmental monitoring of the project results and of the effectiveness of the pilot projects.

One of the most important aspect of *Rewetland* project was the construction of four types of pilot interventions within the Agro Pontino area. This relevance is not linked to the realization of constructed wetland systems, already known to the public and scientific community through many practical cases, but to the testing and verification of the effectiveness of these systems in the territories in which they are made, and their replicability in similar areas.

The pilot projects developed within *Rewetland* project concern mainly four types of case studies, typical of the Agro Pontino area:

- Pilot Project 1: Ecosystem filter in a natural protected area (National Park of Circeo);
- Pilot Project 2: Linear Park of Marina di Latina (in an urban context);
- Pilot Project 3: Buffer strips along drainage canals;
- Pilot Project 4: Good practices for water management within the farm.

### 3.1 Pilot project 1

The Pilot Project 1 provides the creation of a filter ecosystem in a protected area, characterized by a moderate naturalness. It has been located within the National Park of Circeo (coastal sector of the Pontine plain), between the lake of Fogliano and the Cicerchia canal. The operations have carried out in two different areas: near Pantano Cicerchia (Area 1), between the coastal road and the lake of Fogliano, and along the right bank of the Allacciante canal (Area 2).



The filter ecosystem in Region 1, consisting of reeds and wet meadows of new realization, allows to increase the availability of fresh water, partially purified along the river banks of lake of Fogliano, useful for many animals, and to introduce new sweets wetland habitats in an already saline context. Area 2 consists of three artificial basins, with different morphological, hydraulic and natural characteristic.

The importance of the Pilot Project 1 lies not only in the experimentation, for a potential replicability in other areas of the Agro Pontino, but also in the raising sensitization and environmental education that the site offers to the users of the area. In fact, a set of nature trails is an integral part of the pilot project, which lead visitors to discover the rich of *fauna*

and *flora*, highlighting the importance to maintain wetland habitats and their reconstruction (COUNCIL DIRECTIVE 92/43/ECC).

### 3.2 Pilot project 2

The Pilot Project 2 "Linear Park of Marina di Latina" is an example of an urban park that performs the dual function of water phytoremediation, thanks to a system of catchment areas, and recreational use of the area, due to the presence of green areas equipped. The project is located between the Mastropietro and Colmata canals.



The project provides three phytoremediation systems, fed by water coming from the Colmata canal, with more polluting load, and re-entered, treated, in the Mastropietro canal. At the end of the realization of phytoremediation system and of the green areas, a parking space, a dining area and pedestrian and cycle paths have also carried out.

The project's objective is to achieve a usable urban park for the citizens near a constructed wetlands plant. The replicability of this project makes it particularly interesting in the urban and peri-urban areas of Agro Pontino.

### 3.3 Pilot project 3

The Pilot Project 3 "buffer strips along drainage canals" involves the testing of buffer strips in different portions of the pattern of channels managed by the Consortium of Reclamation of the Agro Pontino ("Consorzio di Bonifica dell'Agro Pontino" - CBAP).

The goal is to promote the projects using phytoremediation technology through the creation of buffer zones, in order to collecting the water coming from agricultural areas and purify it by nitrates and phosphates.

The operations have carried out in two different areas (Golena of Astura canal and Selcella canal), as shown in the the figures below.



In the first area were made "*beds of reeds*", in order to recreate similar habitat to the *reed beds*, where water currents are subjected to the action of purifying plants, which are able both to assimilate nutritious substances and to facilitate their degradation at root level by means of aerobic bacteria.

In the second area was made an intervention of "naturalization of the Selcella channel" through the creation of marsh plant communities along the riverbed and an arboreal buffer zone along the embankment on the right bank, in order to facilitate the natural purification processes of water.

Therefore, the goal of the third pilot project is to reduce the tropic loads transported by drainage canals which, collecting the runoff water of agricultural areas, are enriched of nitrates and phosphates.

### 3.4 Pilot project 4

The fourth pilot project differs from previous ones because it is focused on the study of business processes and best practices of water management. It was implemented in a working farm present within the territory of Agro-Pontino: Casal del Giglio. This is an important wine producing firm with more than 150 hectares, located between the towns of Aprilia and Latina.





Within this project has been achieved the Action Plan for the implementation of identified actions in the Master Plan of the environmental multifunctionality of the enterprise, which proposes different possible interventions within the companies, in order to achieve the following objectives:

- ✓ Reduction of water tropic loads resulting from agricultural activities by means of natural purification techniques;
- ✓ Reduction of water consumption by rationalizing, according to an integrated approach, management and use of surface water and groundwater;
- ✓ Environmental requalification and enhancement of existing natural resources.

The testing of this project is therefore based on the identification of the most appropriate agricultural practices, some of which have been implemented already by the farm, and their replicability in other companies. The experiment was structured and organized starting from the analysis of the area under the climatic, geology and hydrology aspects and water needs of wine-making process. The analysis of the context and of the corporate activities led to the identification of good practices that the company has already implemented, such as grassing inter-row, the use of soil organic substances, and the critical issues related to water management.

One of the most critical issue is certainly the surface runoff of rainwater, during periods of high rainfall, which causes surface erosion and sediment accumulation in some of the most depressed areas of the company. The planning implemented by the Province of Latina aims to structuring, over time, a more effective system of runoff of surface waters and to enhance the current capacity of phytoremediation of “*Fosso Valle*”, implementing a series of actions in the same ditch, including appropriate maintenance practices, control of the arboreal stability and the increase of the aquatic plant delegated to the purifying action.

An important aspect is also assumed from the public awareness towards the importance of the agro-ecosystems and of the riparian wetland zones. In fact, the objective is to achieve specific nature trails in order to promote the potential of the network canals and their richness in terms of biodiversity.

#### **4. The contribution of Rewetland project to the awareness of the territory**

One of the key concepts that should be considered in development policies, is the conception of the territory as a resource, therefore not understanding it merely as a container of factors but as a place where create the essential conditions for their success and sustainability. The creation of appropriate territorial conditions for the implementation of these policies is linked to the purposeful and organized local action, in a framework of integration between policies of different scale and partnerships between local actors, major operators and international networks.

The awareness of the territory is preparatory to the ability to rediscover the reality that surrounds us and of which we are an integral part. Besides developing the awareness of the territory, it is fundamental to acquire the relation ability with the heritage that has to be protect and preserve, in order to recover the historical and cultural roots of daily lives.

In this regard, *Rewetland project* understand the current complexity of the Pontine territory, necessary starting point in order to define the initiatives to be undertaken; many actions of the project have been addressed towards studies, analyzes, and other specific techniques activities to achieve the key actions of the project.

Based on the obtained information, it was possible to draw up a report relating the environment's state in the Pontine plain, which allowed to outline an overall policies and environment framework of the Agro Pontino related to water resources. This report was the starting point for the environmental requalification program and supported the planning of the pilot interventions and, even before, the preparation of the feasibility studies of such interventions, in which were highlighted territorial character, the main critical issues and opportunities scenery, the criticality of the water system and the predictions of existing planning instruments.

It was possible to identify the areas suitable where achieve the listed actions, i.e. those in which it was guaranteed maximum environmental compatibility, referring to the relationship between anthropic and natural environment, to the ecological connections and any works aimed to the mitigation of negative impacts. Many other elaborations have been made, generating different scenarios that represent a significant reference for the management of the system.

The result was a considerable depth of awareness of Agro Pontino system from the territorial, hydrological and ecological point of view. The immediate use of such information within *Rewetland project* enabled the realization of the described activities, which represent the substance of the project.

Moreover, regarding the environmental communication, *Rewetland project* pursued the main objective to change the perception of the landscape of the Pontine plain, culturally and historically influenced by land reclamation, altering over

time the balance and naturalness of the ecosystem. The conveyed messages focused on the agriculture role in the water quality management and the dissemination of phytoremediation's techniques for the management of the canals system of Agro Pontino. The communication also aimed to disseminate the information included in the Water Framework Directive on the sustainable use of water and protection of aquatic systems and wetlands.

At local level, the communication was addressed firstly to the farmers and technicians of the sector, namely all subjects directly involved from the problems and solutions proposed by the project. This target is essential for the *Rewetland* project because the environmental outcomes in this area will depend largely on the degree of transposing of good practices identified.

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## Sitography

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