



Project ECOMAWARU

ECO-Sustainable MAnagement of WAtER and wastewater in RUral communities



waste water

phitodepuration

water pollution

PROJECT DESCRIPTION

Sustainable water resource management is a key aspect of the sustainability and ecological compatibility of human settlements, especially **in rural areas**. In line with the objective to reach an ecologically good water status, foreseen in the **water policy framework Directive (200/60/CE)**, the ECOMAWARU project was aimed to test an **integrated water cycle management model** in rural areas (stormwater and wastewater management in hamlets and scattered farmhouses), built on the innovative technique of **microalgae phytodepuration**, a treatment producing biomass from the recovery and reuse of effluents, in accordance with the sustainability policies of Varese Ligure, located in the project's implementation area. In fact the economy of this Municipality is mainly based on tourism, agriculture and zootechnics applying organic cultivation and breeding practices. Varese Ligure was the first European Municipality to obtain in 1999 the **ISO 14001 and EMAS certifications** from the Ecolabel-Ecoaudit Committee.

The implementation of the project activities has interested a very large territory (approx. 14.000 hectares) including 20 small hamlets with approx. 2400 inhabitants. The local waterbodies have an important role both for supplying drinking water and receiving the effluents deriving from human activities, considering also that said territory is not fully served by the public sewerage system. Indeed in the area there are still scattered farmhouses relying only on septic tanks or sometimes on drywells.



OBJECTIVES

The project, of demonstrative character, had the following main objectives:

- **analysis and study of a water and wastewater management model in rural areas applying microalgae phytodepuration as tertiary treatment;**
- **demonstration of the flexibility, feasibility and efficiency of the application of microalgae phytodepuration as tertiary treatment,** used in the scattered farmhouses (rural areas) for wastewater treatment, and in the urban areas to convey part of the effluents from the municipal sewerage system to a tertiary "green" treatment;
- **enhancement of the technological knowledge to be integrated in local level regulations** in order to foster the diffusion of green technologies;
- **transfer of the project know-how,** installation, maintenance, and management as well as control of the microalgae phytodepuration system with the involvement of different stakeholders (local authorities, experts, end-users, etc...).

PROJECT PHASES



The project was articulated in 5 principal phases (as described in the [Final report](#)):

- **Phase 1. Study and analysis of the territory:** review of the scientific literature on phytodepuration systems with the aim to identify and define the main process parameters, climate and environmental variables which can influence microalgae phytodepuration, as well as analysis of the territory of Varese Ligure in terms of wastewater and stormwater management. The collected data were used to implement a GIS platform for water and wastewater management.
- **Phase 2. Planning:** definition of specific technical procedures for a correct implementation of the data collection and validation, as well as of the management, maintenance and monitoring of pilot facilities; design, construction, installation and management of microalgae phytodepuration systems comprised of 4 steps: 1) site selection for the installation of 2 microalgae phytodepuration systems and 2 stormwater monitoring stations; 2) selection of native algal species to be used as inoculum in phytodepuration plants; 3) design and realization of the pilot facilities and monitoring stations; 4) installation and testing of the facilities.
- **Phase 3. Monitoring:** implementation of a monitoring campaign to evaluate the efficiency and criticalities of the microalgae phytodepuration process in different environmental conditions during the four seasons.
- **Phase 4. Analysis of the results and their potential practical reuse:** analysis and assessment of the operational results of the phytodepuration facilities and monitoring stations. Evaluation of a possible reuse of the produced algal biomass and drafting of technical documents as well as regulations.
- **Phase 5. Communication, project management and monitoring.**

PROJECT RESULTS

ECOMAWARU has developed a **water management system based on microalgae phytodepuration**, which offers **significant advantages** compared to traditional treatments, as illustrated below:

- it is a green technology which does not require use of chemical additives and does not produce any sludge, which would require further treatment and disposal;
- simultaneously allows the elimination of nitrogen and phosphorus by photosynthesis from algae and production of biomass without the use of outside organic carbon sources;
- the effluents after the treatment with microalgae are oxygenated;
- microalgae grow much faster than macrophytes and are more efficient in the CO₂ photosynthetic conversion than terrestrial plants, thus they are excellent potential biological agents for the mitigation of carbon dioxide;
- the produced biomass can be also reused;
- treatments with microalgae request smaller surfaces than traditional phytodepuration systems.

Main achievements and products realized in the frame of the project:

- **2 prototype facilities and 2 monitoring stations installed** in 3 experimental sites:
1. **a closed microalgae photobioreactor** (pilot scale), installed at the wastewater treatment plant of S. Pietro Vara (500 PE) in order to refine part of the treated effluent;
 2. **an open photobioreactor (pond)**, installed in Le Pezze in order to refine the effluent pre-treated by an Imhoff tank of a farmhouse (10 PE);
 3. **two stormwater monitoring stations**, installed at the municipal waste depot in the Baghino hamlet, in order to characterize the stormwater runoff at the inlet and outlet sections.

Detailed description of the installation and field testing of the two phytodepuration systems can be found in the [Technical report on the installed systems](#) while the selection process of the microalgae used in the phytodepuration facilities is presented in the [Technical report on the microalgae selection](#).

- **Municipal and regional administrations have been supported in water resource management**, being this latter perceived as a quite urgent problem due to the lack of related guidelines and indications (also regulations), often leading to incoherent interventions on the territory. In particular it is worth mentioning the elaboration of a [draft proposal regarding the use of phytodepuration technique in areas not served by public sewage to be included in the Varese Ligure Municipal Building Code in force](#) and the drafting of a [Manual of best practices "Natural treatment of wastewater"](#), collecting information on the design, installation, maintenance, management and process-monitoring of the phytodepuration systems. This manual is intended to be a useful tool for the local administrations in rural areas providing information on microalgae phytodepuration systems. It is also useful for the replicability of the project in other territories similar to Varese Ligure.



- Creation of a **GIS platform for wastewater management** in Varese Ligure; the uploaded data increased the base of knowledge about the wastewater management on the territory ([Technical report on the creation of the GIS platform](#)).
- **Possibility of reuse of the algal biomass** as fertilizer has been demonstrated and the results of chemical tests of the treated effluents have revealed that it can be also used for irrigation in line with the technical norms on wastewater's reuses laid down in the Decree Law 185/03. See more details in the [Technical report on the microalgae and final effluents' reuse](#). As regards possible further reuses of the algal biomass, studies could be conducted on its reuse as organic material in anaerobic digestion systems for the production of biogas.
- Further technical documents are available in the project site's [download](#) section, among which:
 - [Technical report on the microalgae practices](#)
 - [Technical report on the data collected during the monitoring campaign](#)
 - [Technical report on the achieved results](#)



Acronym
ECOMAWARU

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[LIFE](#)

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471.186

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Description

Comune di Varese Ligure