



## **Water quality and agricultural practices: the case study of southern Massaciuccoli reclaimed land (Tuscany, Italy)**

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Owing to increasing anthropogenic impacts, lagoons and wetlands are being exposed to environmental degradation. Therefore, the sustainable management of these environmental resources is a fundamental issue to maintain either the ecosystems and the human activity.

The Massaciuccoli Lake is a coastal lake of fresh to brackish water surrounded by a marsh, which drains a total catchment of about 114 km<sup>2</sup>. Large part of the basin has been reclaimed since 1930 by means of pumping stations forcing water from the drained areas into the lake. The system is characterized by:

- high complexity of the hydrological setting;
- subsidence of the peaty soils in the reclaimed area (2 to 3 m in 70 years), that left the lake perched;
- reclaimed land currently devoted mainly to conventional agriculture (e.g.: maize monoculture) along with some industrial sites, two sewage treatment plants and some relevant urban settlements;
- social conflicts among different land users because of the impact on water quality and quantity.

The interaction between such a fragile natural system and human activities leads to an altered ecological status mainly due to eutrophication and water salinisation.

Hence, the present work aims at identifying and assessing the sources of nutrients (phosphorous in particular) into the lake, and characterising land use and some socio-economic aspects focusing on agricultural systems, in order to set up suitable mitigation measures.

Water quantity and quality in the most intensively cultivated sub-catchment, placed 0.5 to 3 m under m.s.l. were monitored in order to underlain the interaction between water and its nutrient load. Questionnaires and interviews to farmers were conducted to obtain information about agricultural practices, farm management, risks and constraints for farming activities.

The available information about the natural system and land use were collected and organised in a GIS system: a conceptual model of surface water hydrodynamics was build up and 14 sampling points were monitored monthly during 2008-2009. The main water physical and chemical parameters, including nutrients, as well as the principal soil types within the sub-catchment were analysed.

First results point out:

- the reclaimed land presents a dense drainage network hydraulically interconnected with the shallow aquifer;
- surface waters present a high chemical heterogeneity: three main hydrochemical facies were identified and compared with nutrients contents and soil chemistry;

- artificially induced recharge to the reclaimed land aquifer occurs by means of lake water infiltration. This forces the pumping stations to remove an additional amount of water in order to allow land cultivation;
- the water salinity in the drainage network may increase during summer period. This could be related both to irrigation using lake water and a further contribution due to evapotranspiration processes;
- agricultural land use changed during the last 15 years, and shifted to less intensive farming practices. Fertilization levels dropped from 200 and 150 to 100 and 50 kg/ha N and P<sub>2</sub>O<sub>5</sub> respectively, and the irrigated area decreased from 50% to 40% of the total utilised agricultural area;
- in the low land peaty area, the higher content of sulphate and phosphate in the drainage water supports the hypothesis that peat degradation could be a relevant source of nutrients.

As a result, the impact of fertilizer use on the water quality is limited, while land management (e.g. water use and land reclamation) constitutes the key issue.

Therefore, local stakeholders participation, farmers above all, should be supported in future management and planning actions in order to adapt socio-economic needs with the peculiar biophysical conditions.