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Reclaimed peatland for agriculture: implications for water and farming management in Mediterranean areas

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During the last century, reclaimed peatland played an important role in increasing farmland mainly due to the possibility of dewatering wetlands using pumping stations. These wetlands were generally sustained by the presence of shallow phreatic aquifers, whose water table was, and it is still today, then lowered by the presence of a dense ditch network. Nevertheless, such land management leads to environmental problems, of which subsidence undoubtedly is the greatest problem when attempting to sustain agricultural activities (Andriesse, 1988).

Around the Massaciuccoli Lake (Tuscany, Italy) six peatland areas (*Bonifica*) of about 32 km^2 were reclaimed between 1920 and 1930, after a struggle lasting about 2000 years. As soon as reclamation started, subsidence began (2 to 3 m in 70 years), leaving the lake perched and central respect the low drained areas, now 0 to -3 m below m.s.l., and requiring 16 km embankment construction. Moreover, during the last 40 years eutrophication phenomena arose and it was thought to be due to excess crop fertilization.

In order to get a deeper insight on such problems, a survey of groundwater and surface water quality along with hydrological monitoring and agriculture surveys was carried out in 2008-2009 in the most intensively cultivated reclaimed areas (Pistocchi et al., 2010).

Results show that peat subsidence may have several serious consequences in farmland management. Drainage should be now adapted to new levels because pumping stations cannot reach the required groundwater head for farming (the so-called *Devil's circle for peatland exploitation*) and large pieces of land are already uncultivated. Subsiding areas are also at high risk of inundation and flooding.

Moreover, areas interested by much severe subsidence shows also notable orthophosphate values in groundwater, ranging from 5.5 to 0.3 mg/l, being even one order of magnitude higher than those detected in surface water. We hypothesize that besides a potential agricultural origin, phosphorous presence in groundwater may be related to peat exposure and mineralization related to the drainage of waterlogged and anaerobic peat turning, then, to aerobic conditions (Rossetto et al., 2010). Agricultural practices, such as tillage, may enhance phosphorous input by increasing organic matter oxidation. As peat soils in the study area show high organic matter content (up to 40%), mineralized phosphorous quantity, calculated using annual mineralization rate typical under Mediterranean climate, suggests an important contribution to groundwater. Phosphorus in groundwater might be then of ecological concern especially during base flow conditions, when groundwater contributions to surface water are greatest and are coincident with optimum temperature conditions for primary production. An increase in carbon dioxide emission is expected also, but no data is still available.

Options for mitigating these adverse effects caused by subsidence are currently being evaluated. They are related to changes in the cropping systems, i.e. long term crops (such as short rotation forestry, forage crops or saturated pasture) or in farming practices (e.g. no or minimum tillage) in order to reduce mineralisation, and/or to changes in land use. The latter include options such as shallow flooding (which might also lead to organic matter accumulation and then reverse subsidence) or deep flooding to create open-water habitat.

References

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