

# WILDFIRE EFFECTS ON SOIL AND WATER QUALITY IN A SEMI-ABANDONED RURAL AREA OF NE SPAIN

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## Abstract

Rural abandonment of hillside soils in the Mediterranean region may have beneficial or detrimental effects on soil properties and water availability depending on post-abandonment land management and also degree of soil resilience. When agro-forestry practices fail, early-diffused dense shrub-dominated areas are often affected by repeated wildfires, which may severely affect both soil and water quality. Damaging effects on soil properties may also be expected when partial abandonment occurs and soil is continuously exploited without any replacement of organics for fertility reconstitution. In both cases, increase in structure deterioration and crusting may produce higher overland flow, resulting in accelerated erosion and nutrient depletion and the concentration of soluble compounds in runoff water may increase as well.

The Serra de Rodes cathment (approximately 600 Ha) is located in the Alt Empordà, NE Spain). Mean annual rainfall is 450 mm and mean temperature 18° C. The wind “tramuntana” is especially strong all over the area. Lithic Xerorthents formed on granites and granodiorites are predominant and soil properties vary with the varying canopy cover. Soils are generally shallows with a maximum depth of 30 cm. This research is part of a national project studying the effect of land abandonment on soil physical, chemical, biological and hydrological properties and deals with the determination of soil and water quality parameters before and after the wildfire occurred in the area the 7<sup>th</sup> august 2000 which was of strong intensity (temperatures over 350° C were recorded) and destroyed all the vegetation but cork trees.

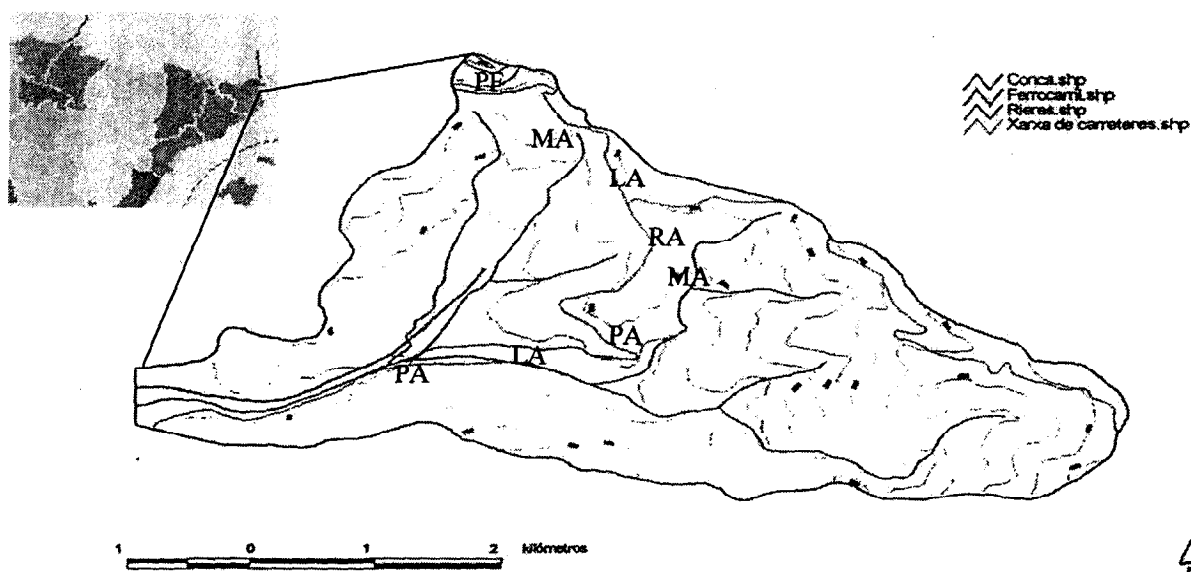


Fig. 1. The Serra de Rodes cathment and the experimental sites.

Previously identified environments included: Partial Abandonment (PA) where vineyards and olive trees are still cropped without any soil management; Recent Abandonment (RA), the first step of agricultural release (from 5 to 25 years of total abandonment) colonised mainly by *Brachipodium retusum* and *Lavandula stoechas*; Middle Abandonment (MA) (25-50 years of total abandonment), colonised mainly by *Cistus monspeliensis*, *Cistus albidus* and *Calicotome spinosa*; Late Abandonment (LA) (>50 years of total abandonment) mainly vegetated by *Erica arborea* and *Quercus suber*; and old Pine Forest (PF) as an example of afforestation carried out in the fifties to vegetate ancient burned areas. These environments may represent the natural evolution from low managed crops to the latest abandonment or agroforestry management under the periodical effect of wildfires which have produced a continuous auto-succession of the vegetation leading to the specialisation of very opportunistic species. At the moment of environment's selection the last wildfire had occurred in 1986. Soils were sampled in each environment at 0-15 cm depth at random after any rainfall event during the entire period of observation, that is from January to December 2000.

By analysing the soil samples since the beginning of the 2000, it was possible to compare a period of six months before and six months after the fire of the august 2000. Texture, Moisture (M) and Water Holding Capacity (WHC), Bulk Density (BD), Mechanic Impedance (MI), pH, Soil Organic Matter (SOM), Total nitrogen (TN), Cation Exchange Capacity (CEC), and exchangeable cations (Ca, Mg, Na, K) were determined six times in the whole period of study. Moreover, after any rainfall event (six events in total) sediments were collected from erosion tanks, weighed and analysed for organic carbon (EOC) and total nitrogen (ETN). Also dissolved organic carbon (DOC), dissolved organic nitrogen (DON), electrical conductivity (EC), pH, and soluble cations (Ca, Mg, Na, and K), were analysed in the collected runoff water.

Results show that before the wildfire the age of abandonment enhances soil water holding capacity and nutrient reserve due to the accumulation of organic litter and enrichment of humus compounds in the organic horizon. Nevertheless, surface nutrient depletion by overland flow was relevant in the order of *Cistus* (MA) > Pine Forest (PF) > Cork (LA) areas. The highest sediment yield was found in the partially abandoned fields (PA) whilst the recent abandonment (RA) was the most stable environment probably due to the presence of grass (*Brachipodium retusum*) which allows the formation of a better structure, also lowering the removal of dissolved nutrients like DOC and DON. After the wildfire a steep increase in runoff and sediment yield was observed and the content of organic carbon and nitrogen either in the eroded soil or in the runoff water increased to a large extent. Drastic modification of pH and electrical conductivity were supposed to be beneficial in these soils showing an acid reaction.

It is of particular importance to investigate areas repeatedly devastated by fire and a special attention must be devoted to those areas like the Serra de Rodes which present a reduced soil depth and a pool of soil properties that announce a relatively high vulnerability to degradation and desertification. By the continuous monitoring of soil quality parameters it is possible to detect early warning indicators and suggest proper management plans.

**Key-words :** Spain, Serra de Rodes, Wild fire, Land use, Soil & water quality,

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