ENVIRONMENTAL IMPACTS OF OUTDOOR PIG PRODUCTION: EFFECTS ON P SORPION

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Objectives

The main objectives of this work were to evaluate the impact of outdoor pig production on (i) soil P sorption capacity and on (ii) spatial change of soil P sorption capacity.
The experimental area of outdoor pig production, began on January 2005. It has 2.8 ha divided into 6 paddocks (Pk), with an animal charge of 1 136 m^2 / animal adult, on average 9 adults / ha (Figure 1). The soil is a dystric cambisol (WRB, 2006). It is localized at a farm that belongs to the Polithecnic Institute of Castelo Branco_Portugal.

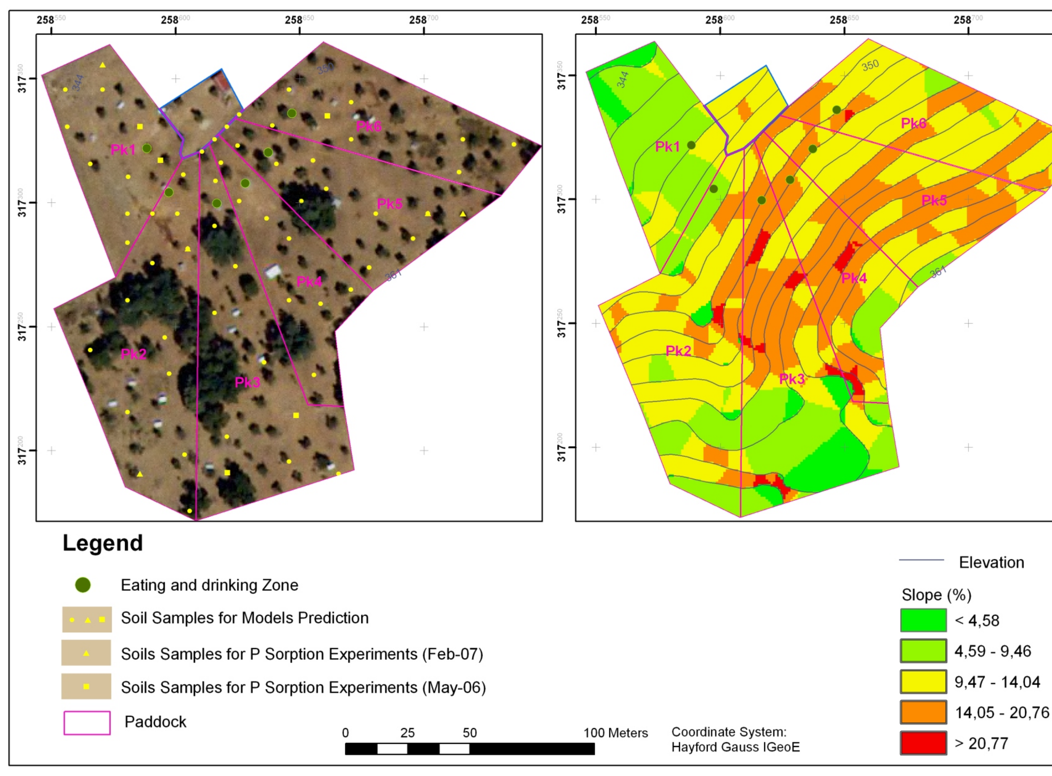

Fig. 1 - Outdoor pig production area with the paddocks, feeders and well's points, slope and altitude of the area.

Material and Methods

On May 2006 and on February 2007, 11 soil samples were taken for P sorption experiments. Figure 2 shows the localization of the sampled points. These soils samples had different values of P_Olsen and Organic Carbon (Figures 2 and 3).
Soil P sorption evaluation was made by isotherms procedure similar to the methodology used by Fox and Kamprath (1970). Sorption data were adjusted to Langmuir or Temkin equations.

$Qs = (K \times Q_{max} \times C) / (1 + K \times C)$ Langmuir isotherm
Qs = soil P sorbed (mg kg^{-1})
Q_{max} = maximum value of P sorbed by soil P (mg kg^{-1})
K = soil affinity constant (L mg^{-1})
C = Soil solution P concentration (mg L^{-1})

$Qs = a + b \times \ln C$ Temkin isotherm

P and organic carbon inputs in this area are due only to feed and pig's excretions.

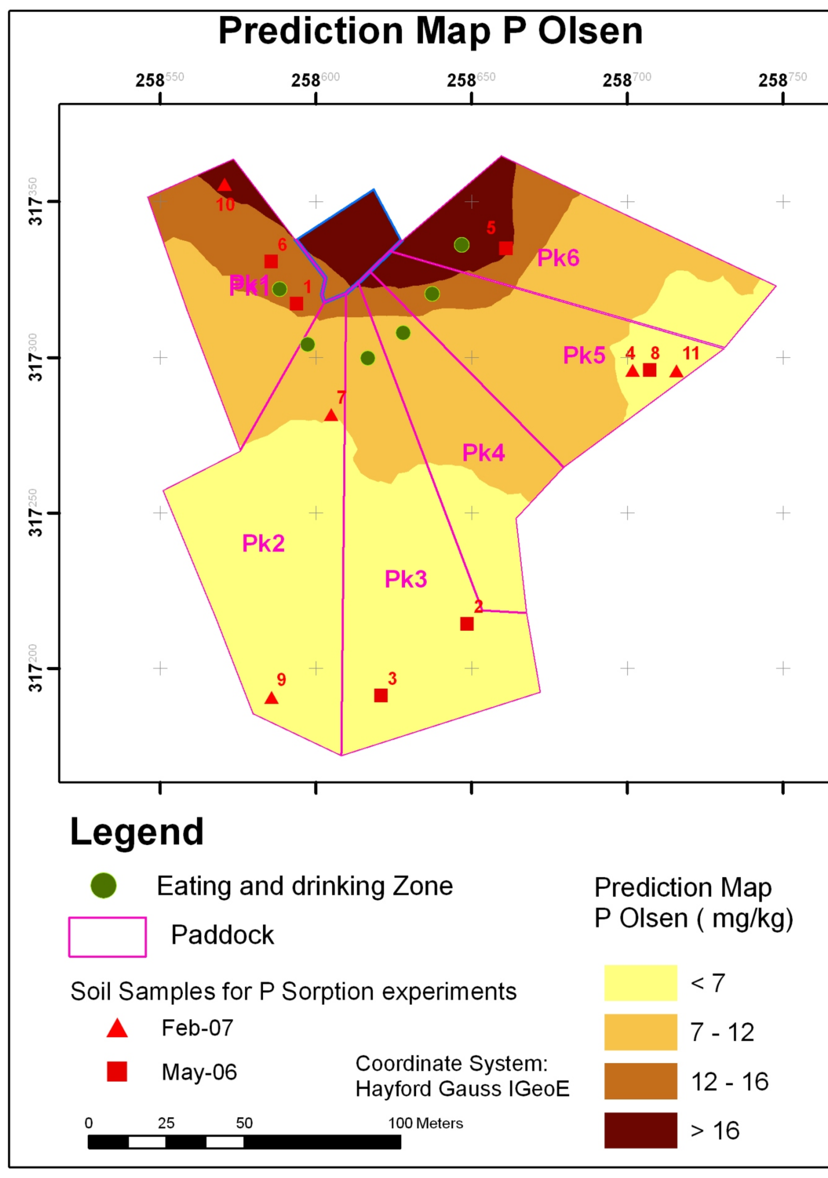

Fig. 2 - Spatial distribution of P_Olsen on February of 2007 (initial P_Olsen value of 7 mg kg^{-1})

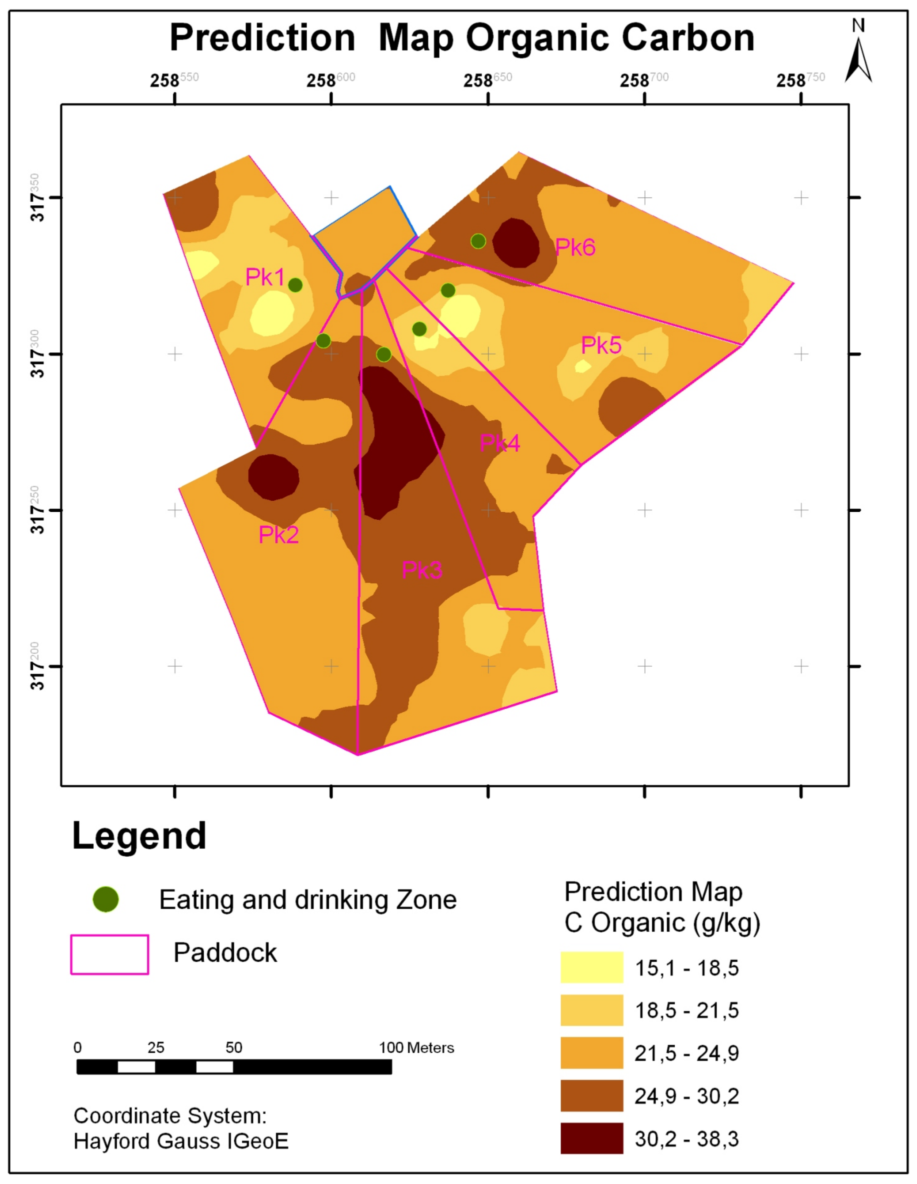

Fig. 3 - Spatial distribution of organic carbon on February of 2007 (initial organic carbon value of 8 g kg^{-1})

Results

Figures 2 and 3 show that after 2 years of outdoor pig production there is an increase of bioavailable P and of organic matter in the experimental area. Soil erosion and runoff waters transport and accumulate bioavailable soil P forms to the area with lower altitude and slope.

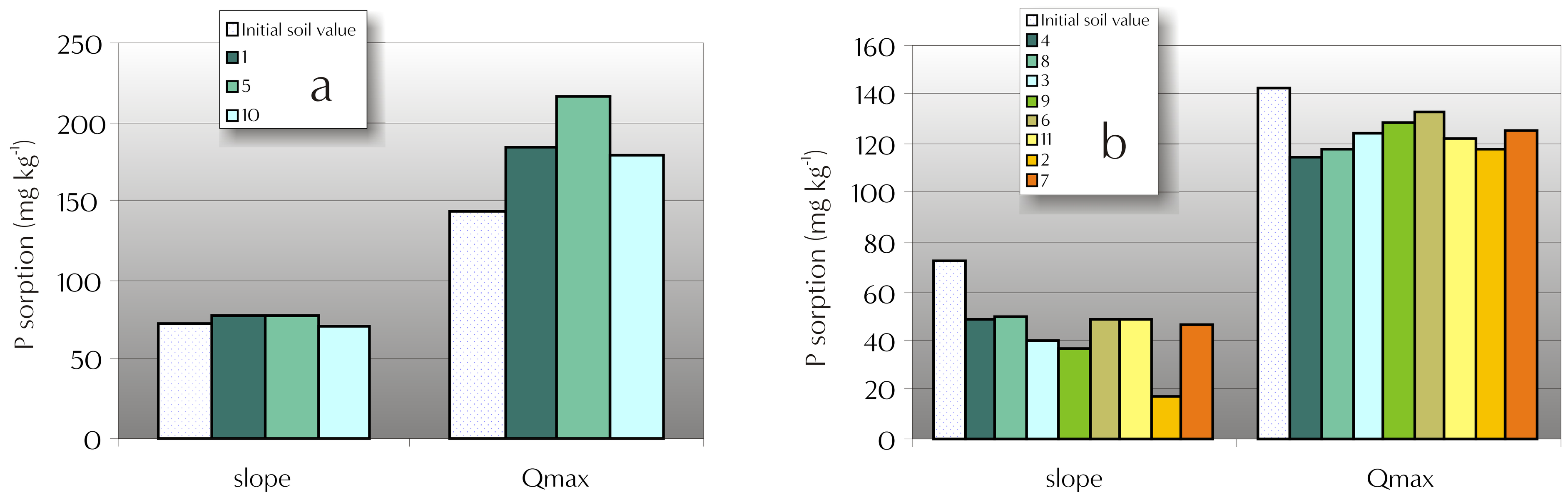

Fig. 4 a,b - P sorption maxima (Langmuir isotherm) and slope (Temkin isotherm) of soil samples

Sorption data shows that this soil has a low P sorption capacity, evaluated by Langmuir isotherm, with a value of Q_{max} = 142 mg P kg^{-1} (Initial soil value, Figure 4). We can observe also that after 2 years of outdoor pig production there are a high spatial variability in soil P sorption namely Q_{max} values between 114 and 216 mg kg^{-1}.
Moreover, some soil samples exhibited an increase in P sorption capacity due to the creation of additional sorption sites with similar bonding energy (Figure 4 a) and another group of soil samples exhibited a decrease in P sorption capacity (lower values of Q_{max}) probably due to a decrease in the affinity of P sorption sites or permanent blocking of sorption sites (decrease of slope values, Figure 4 b).
Soil erosion leading to downward transport of silt and clay particles may explain this increase in P sorption in the area with low slope and altitude, where these particles can accumulate and create additional sorption sites. At the other points of the experimental area loss of P sorption particles and an increase in organic matter may justify the decrease in soil P sorption capacity.
The decrease in P sorption capacity in most of this experimental area could have an important environmental impact as it increases the risk of superficial waters eutrophication due to increasing P transfer from soil to drainage or runoff waters.

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