

Mitigation of Nitrogen leaching with agroforestry : an assessment in various soil and climate conditions of the Rhône River watershed in France with the Hi-sAFe model.

Gendron Thomas¹, Dupraz Christian¹, Lecomte Isabelle¹, Gosme Marie¹

¹ INRAE, UMR Absys, University of Montpellier, Montpellier, France

Nitrogen leaching from cropped areas is a concern as it contributes to groundwater contamination, and underutilized soil fertility. The intensity of leaching is affected by soil type and structure, the amount of water used by the plants/crops; and the quantity of nitrate present in the soil. High levels of nitrate leaching are frequent in monocropping during heavy rain seasons, especially when these rains occur during warm seasons that favour mineralization of soil organic matter. This concern is high in the Rhône River watershed in France, where heavy Mediterranean type rains occur in early autumn.

We used the Hi-sAFe biophysical model to assess the impact of agroforestry trees in alley-cropping on Nitrate leaching for different soil and climate conditions of the Rhône River watershed. The model predicts the impact of trees on both the water and the nitrogen dynamics in the soil, taking into consideration the 3D structure of the tree root system, and the phenology of the trees. Simulations were performed for the whole tree life cycle (40 years long) in order to detect the minimum size of the trees that will impact the nitrate leaching process.

Complex patterns of nitrate leaching are evidenced, but common trends are as follows: AF systems surprisingly do not modify significantly the total annual water drainage, reduce soil evaporation, reduce water run-off, and substantially reduce Nitrate leaching in most cases (Figure 1). The model allows to identify mechanisms that explain the site by site differences in nitrate leaching.

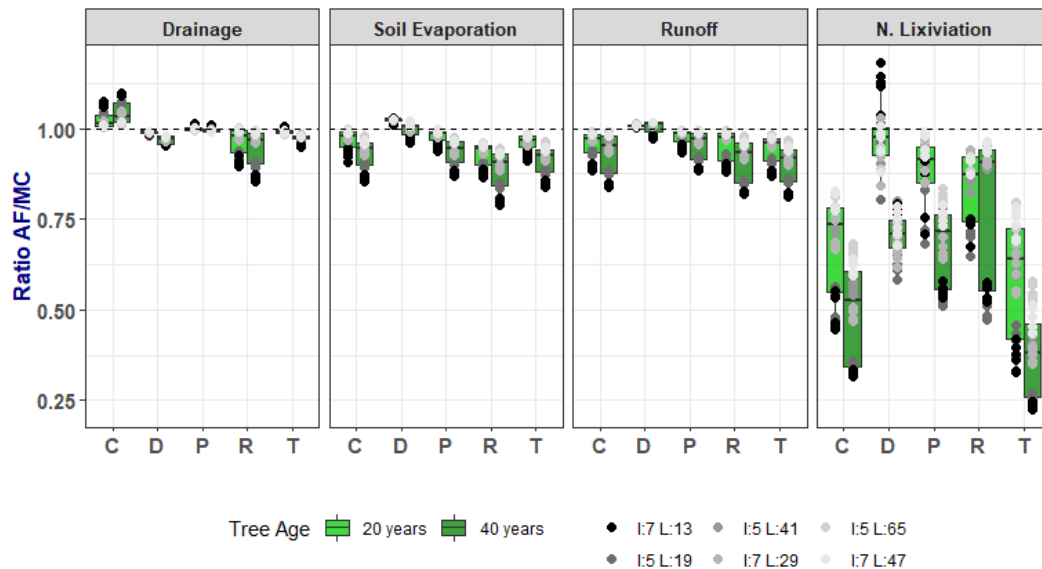


Figure 1: Relative Drainage, Soil evaporation, Run-off and Nitrate lixiviation ratios (AF/MC) predicted by the Hi-sAFe model for five sites (C, D, P, R, T) of the Rhône River watershed. The ratios are calculated for trees aged 20 (left, light green) and 40 (right, dark green) years respectively. The different symbols account for different tree densities indicated by distance between trees on the line (l) and distance between tree lines (L).