Spatial heterogeneity of extensively grazed watersheds. Consequences for the modeling of the fate of fecal micro-organisms and the quality of superficial waters.

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The quality of superficial water of extensively grazed watersheds is substantially affected by critical source areas. The latter correspond to demarcated areas whose location may vary in space and time according to environmental factors and farming practices.

The objective of our work was to identify the critical source areas involved in the microbiological quality of superficial water of extensively grazed watersheds in mountain area. In such conditions, soils are characterized by a strong spatial diversity in terms of intrinsic properties, vegetation biomass or amount of cow-pats deposition. This leads to a great spatial heterogeneity of both the release and transfer of microbial pollutants.

To identify the zones where there is a spatial and temporal coincidence between a source of contaminants and superficial runoff one need models that explicitly take in account this heterogeneity and noticeably the interactions between cow-pats deposition and evolution, together with soils hydrodynamic. We have developed such an approach by analyzing the studied area within a geographical information system and identifying the pixels giving rise to bacteria and runoff. These critical pixels are defined by modeling the distribution and evolution of cow-pats and the variable sources of surface runoff. The flows of fecal bacteria (E. coli) transmitted to the outflow of the watershed are calculated by accumulating the unit bacterial flows originating from critical pixels. Functions for bacterial emission from the cow-pats and for retention during their transmission to the drainage basin outflow are calibrated by inverse analysis.

Along the course of the water flow, the bacterial retention on the surface of the soils is very influential. Nevertheless the contents in the water remain very high and basically it is the age of the cow-pats, the volumes of runoff water, the location and the proportions of bacteria-emitting and non-emitting surfaces which determine the critical source areas, flows and contents at the watershed outflow. These data are discussed to find out solutions for the managing of watercourses and grazing practices.