Geophysical Research Abstracts,
Vol. 11, EGU2009-10916, 2009
EGU General Assembly 2009

Natural and induced endoreic hydrological conditions in the Alta Murgia karstic region (Apulia, Southern Italy)

F. Canora (1), M.D. Fidelibus (2), and G. Spilotro (1)

(1) Dept. of Structures, Geothecnics and Engineering Geology, University of Basilicata, Potenza, Italy; giuseppe.spilotro@unibas.it, (2) Dept. of Civil and Environmental Engineering, Technical University of Bari, Italy; d.fidelibus@poliba.it

A study aimed at understanding the hydrological processes in karst areas related to the presence of natural and artificial endoreic basins and their modification due to land use change, as well as the influence of above factors on the infiltration rate has been carried out in the Alta Murgia region (Apulia, Southern Italy).
The region is a Cretaceous limestone plateau of the Apulian platform, characterized by a mature karstic landscape: due to its elevation, climatic conditions and lithology, the plateau constitutes the main recharge area of the Murgia aquifer. The typical karst topography is essentially related to the subterranean drainage (sinkholes, caves, conduit): surface and subsurface karst geomorphology is strictly interrelated with hydrology. The morphological features of the karstic plateau are defined by the high density of surface karstic forms (mainly dolines), the presence of exposed karst and karren fields, as well as by the extensive outcrop of fractured rocks. Karst surface shows, on the bottom of the morpho-structural depressions called “lame”, natural distribution of modest deposits of “terra rossa” and regolith.
The “lame” work as streams during and after intense rainfall events, often outlining a primordial ephemeral hydrographical network, frequently convergent towards dolines, poljes or endoreic basins.
Alta Murgia shows many natural endoreic basin conditions in a quite flat morphology. In this environment, when intense rainfall events cover large areas and rainfall intensity exceeds the infiltration capacity of soils and/or sinkholes, significant runoff amounts are produced and stored in the basins causing floods. Most of the natural endoreic basins are small and independent: while the majority of them continue functioning as endoreic even in presence of extreme events of high return time, others (quasi-endoreic), under the same circumstances can start contributing to other basins, due to exceeding their water storage capability. This way, very large flow can cascade down towards more depressed areas.
Another important feature of the Alta Murgia territory is that the whole area is characterised by a high degree of division into parcels, physically delimited by a well developed network of drystone walls.
These have been built during centuries by using stones retrieved from the same fields, having the main role of preserving soils from erosion. The drystone walls that limit the parcels define induced endoreic conditions, where runoff, mostly prevented from discharging out, rather converges toward natural drainage systems and internal depressions, where afterwards infiltrates: the walls allow a high infiltration rate of precipitation of low and medium intensity with low evapotranspiration, while the runoff basically activates only during highest intensity events. The drystone walls have preserved in the time the characteristics of the karst surface, with its high hydraulic conductivity consequent to the negligible outcrop of soils; because of their capability of decreasing the runoff triggering threshold, drystone walls have always worked positively inside the endoreic and quasi-endoreic basins.
The above characteristics of both natural and artificial endoreic basins indicate that the definition of the water balance for the Alta Murgia aquifer is complex, requiring a model able to take into account, not only the absorption capacity of the karstic surface textures (which, indeed, are able to delay the start of the runoff due to the need to reach first the saturation of terra rossa in the fissures, pockets and fillings of karst hollows) but also the hydraulic behaviour and geomorphological features of the basins constituting on the whole the recharge area.
To make the situation even more complex, in the last decades, the territory was subject to a particular type of land use change, the stone shattering (that is performed by crushing and grinding the karst surface), aimed at making suitable the parcels for mechanized agriculture. While the original situation of Alta Murgia recharge area was able to assure the best conditions for high infiltration rate, not only for the positive role of the drystone walls in holding

the soil and slowing down the runoff, but also for the morphological characteristics of the karstic surface textures, stone shattering, by flattening and deeply modifying large part of the original karstic textures and landscape and by demolishing drystone walls, produced severe alteration of the hydrological behaviour of surface and epikarstic textures, increase of runoff and erosion, and substantial geomorphological variations. The land use change thus caused a significant damage to the fragile karstic environment, increasing its vulnerability, and clearly modifying the hydrogeological balance.

To assess the impact of endoreic (natural and induced) conditions on the water balance and the significance of the karstic textures modifications, field and laboratory surveys have been carried out for defining at field scale the hydraulic and physical characteristics of the epikarstic textures and their influence respect to the flowing runoff threshold. Such a characterization was mainly aimed at assessing their infiltration capacity. Moreover, detailed geomorphological surveys, in situ investigations, and aerial photo analysis were used to verify the role of the endoreic (natural and induced) conditions, in order to define their control on hydrogeological processes.

Simulations of the water balance carried out in a selected part of the recharge area subject to land use change, which originally included natural surface textures and drystone walls.

The comparison between the infiltration rate in the natural conditions (by considering the role of natural endoreic basins and a variable retaining capability of induced endoreic conditions created by drystone walls) and that one calculated for the present situation (stone shattered soil with geomorphological variations due to demolition of walls) indicated a significant decrease of the infiltration rate.