Geophysical Research Abstracts
Vol. 13, EGU2011-8314-1, 2011
EGU General Assembly 2011

Impact of land conversion from fallow to rain-fed and irrigated crop fields on aquifer recharge in semiarid Niger

Maïmouna Ibrahim (1,2,3), Guillaume Favreau (2,3), Jean Luc Seidel (1), Mathieu Le Coz (1), and Boureima Ousmane (3)

(1) Université Montpellier 2, UMR 5569 HSM, Place E. Bataillon, CC MSE, 34095 Montpellier, France, (2) Institut de Recherche pour le Développement, UMR 5569 HSM, Avenue de Maradi, BP 11416, Niamey, Niger, (3) Université Abdou Moumouni, Faculté des Sciences, BP 10662, Niamey, Niger

In semiarid sub-Saharan Africa, the rapid population growth (∼3% yr-1) during the past few decades has resulted in land clearing and large-scale conversion from savannah and fallow to crop fields. As a consequence, surface and sub-surface water fluxes have dramatically changed in time and space. Depending on soil (surface) characteristics and land use, this may result in different time lags and long-term consequences on groundwater resources. In semiarid Niger, in order to estimate changes in water and solute fluxes through time, hydrodynamic and chemical characteristics within the vadose zone at three sites (2 in SW Niger, 1 in SE Niger) were investigated during three years (2008-2010). Samplings were performed from the soil surface down to 5 - 26 meters on different land use: fallow with small savannah shrubs, rain-fed millet crop and irrigated capsicum crop.

Soil water content (neutron probe surveys - NP) and matric potential (MP) were measured at a daily (MP) to weekly (NP) frequency to determine direction of water movement. Soil water chemistry (ionic tracers, including chloride), electrical resistivity profiles (DC) and gravimetric water content were measured at the drilling time period (dry season). Soil surface conditions were monitored at fallow and rain-fed sites with two cameras fixed to take pictures at 5 minutes-frequency to understand spatial distribution of surface runoff during intense rainfall events. Hydrus-1D code was used to determine the sensitivity of both water and solutes fluxes to soil surface conditions and hydraulic properties of the porous media (grain size, density, soil conductivity).

Results show that the fallow sites have lower MP (-0.2 m to -4000 m) than rain fed sites (-0.9 m to -100 m). Both land use types showed no flux below 2.5 m during the MP and NP surveys. This discrepancy suggests a different functioning during more intense rainfall events. Soils under irrigation show higher but more variable matric potentials (-0.8 m to – 80 m) attributed to spatial variability in drainage related to differences in clay content at surface. For mean hydraulic properties, preliminary 1D simulations show that conversion from rain-fed to irrigated cropping results in a 100 mm.yr-1 increase of recharge rates. All profiles show low ionic contents (0 to 60 mg/L) for chloride), and modelling suggests low to moderate natural historical salt accumulation.

These preliminary results highlight the need to survey and simulate the impact of rainy years to better estimate drainage rates and confirm the importance of considering land use as a primary factor controlling aquifer vulnerability at large scale in semiarid regions.