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Physico-chemical aspects of sustainable water management: preventing salinity and sodicity

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In large areas worldwide, both in semi-arid and temperate, humid climates, the availability of good quality water for primary production in agriculture or natural vegetations is limited. Whereas soil and groundwater pollution are nowadays general problems, much larger areas have to deal with the hazards of soil and groundwater salinity. Salinity is a problem if groundwater is of poor quality and in hydrological contact with the root zone, or used for irrigation. In case of seasonal drought, soil containing swelling minerals, and an unfavourable sodium fraction in water (high sodium adsorption ratio SAR), also sodicity (expressed by ESP, exchangeable sodium percentage) may be a hazard. Sodicity may cause soil structure deterioration, that can be practically irreversible. Whereas often salinity can be prevented by leaching, the stealthy process leading to sodicity should therefore be prevented, lest soil as a resource is adversely affected for decades or centuries. Moreover, salinity may be recognized visually (white crystals at soil surface), but sodicity in general not. Therefore, management that is directed towards sustainability, preventive rather than curative, should be based on convincing and transparent concepts, and preferably use simple (analytical) tools. In this presentation, analytical solutions are presented to avoid salinity and, in particular, sodicity. The solutions concern the rate with which salinity and sodicity, respectively, change towards their long term levels, taking into consideration the stochasticity of rainfall/irrigation. Also the magnitude of long term salt concentration and of ESP is approximated analytically. The value of these analytical solutions is, that very simple characteristics can be derived, that enable the risk assessment without needing a computer. The solutions are compared with numerical simulations, to demonstrate their validity. Furthermore, they are applied to a test case for situations in Tunesia.