Sustainable Eco-Systems under Land Retirement

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The analysis of data on the evolution of vadose zone salinity and perched water levels from Land Retirement Demonstration Project at Tranquillity site located in the Western Fresno County show that effective unsaturated soil hydraulic property change with average soil water salinity.

Use of intensive irrigation in arid and semi-arid areas usually leads to gradual salination of the soil, detrimental to crop-yields. The salination problem is mitigated by applying irrigation in excess of crop requirements, which leaches the excess salt load to the groundwater. Lack of appropriate natural or man made drainage systems to dispose off this excessive saline recharge to the groundwater leads to a gradual rise in the water table eventually encroaching upon the root zone. This may ultimately make the land unfit for any productive agricultural activity. The abandoned land may even lead to desertification with adverse environmental consequences. In closed drainage basins, land retirement has been proposed as a management tool to address this problem. Land retirement essentially entails intentionally discontinuing irrigation of selected farmlands with the expectation that the shallow water table beneath those lands should drop and the root zone salinity level should decrease.

In the San Joaquin Valley of California, intensive irrigation in conjunction with a shallow underlying layer of clay, known as the Corcoran clay layer, and absence of a drainage system caused the root zone to become highly saline and shallow water table to rise. Land retirement would remove from production those farmlands contributing the poorest quality subsurface drain water. Based on numerical models results, it was expected that with land retirement of substantial irrigated lands with poor drainage characteristics, beneath which lies shallow groundwater with high salt load, the shallow water table beneath those lands should drop. A part of the retired lands could also be used for wildlife habitat. A potential negative side effect of the land retirement option is that in certain evapotranspiration enabling soil and water table conditions, water will be drawn upwards and evaporated, leaving a deposit of salts on the surface and in the root zone. The deposits of salt on the surface may then be wind blown to adjacent areas creating a potential environmental hazard.

Using field results from the Land Retirement Demonstration Project at the Tranquillity site in western Fresno County, operated by the U.S. Department of the Interior, principles of mass balance in a control volume, the HYDRUS-1D Software Package for Simulating the One-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably-Saturated Media, and PEST, a model-independent parameter optimizer, we investigated the processes of soil water and salinity movement in the root zone and the deep vadose zone. The simulation covering a time span of 5 years used measured perched water table depth and changes in the average root zone soil salinity as given by electrical conductivity measurements to optimize soil water retention properties, solute transport parameters and downward flux values at three locations of the Tranquillity site. A new paradigm changing 'bottom up approach' to sustainable land manage-

ment for drainage impaired land is proposed. With this “bottom up approach” it is feasible to design a sustainable land use regimen for drainage impaired lands in general and retired lands in particular. The analysis of data on the evolution of vadose zone salinity and perched water levels also show that effective unsaturated soil hydraulic property change with average soil water salinity.

Publications

Singh, P. N., W. W. Wallender, M. P. Maneta, S. L. Lee and B. A. Olsen. 2009. Sustainable root zone salinity and shallow water table in the context of land retirement, Journal of Irrigation and Drainage Engineering ASCE, In Press.

Professional Presentations

Singh, Purnendu and Wesley Wallender Land retirement in the west San Joaquin Valley: Role of soil hydraulic properties and attenuation for sustainable root zone salinity, American Society of Agricultural & Biological Engineers (ASABE) annual international meeting, June 21-June 24, 2009 Reno, Nevada.

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