Sustainable Eco-Systems under Land Retirement

Wesley W. Wallender
Department of Land, Air and Water Resources
University of California, Davis

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 of 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

Retired land on the Westside of the San Joaquin Valley

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 management for drainage impaired land is proposed. With this new 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 properties change with average soil water salinity.

Professional Presentations

Singh, Purnendu and Wesley Wallender, Sustainable root zone salinity in the context of shallow perched water table, and attenuation: Land retirement demonstration project in the west San Joaquin Valley, California Central Valley Groundwater Modeling Workshop, Berkeley CA, July 10-11, 2008.

Wallender, Wesley and Purnendu Singh, Land Retirement: Root Zone Salinity in the context of shallow region groundwater conjunctive use and attenuation, University of California Salinity and Drainage Conference, Sacramento CA, March 26, 2008.

Singh, Purnendu and Wesley Wallender, Land Retirement as a Habitat Restoration Tool, AGU Fall Meeting Poster, San Francisco CA, December, 2007.

For further information please contact:

Wesley W. Wallender
wwwallender@ucdavis.edu
530-752-0688
enthusiasm.ucdavis.edu