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Modelling soil salinization processes for sustainable irrigation management

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Problems of soil salinization and soil pollution are especially important in irrigated agriculture, because they may affect negatively the physical and chemical soil properties, the crop production and the animal and human health. The fast development of irrigated agriculture, with increasing conflicting use of the scarce water resources of good quality, has been associated in many cases with an increase in soil salinization and soil pollution. The benefits derived of irrigation of agricultural lands may not be sustainable due to the development of salt-affected soils, with a partial or complete loss of the soil productive capacity. Another factor to be considered is the increasing contribution of drainage waters from irrigated lands to contamination of soils and waters by salts, nitrates and other pollutants coming from the organic and inorganic products used in the intensively used irrigated fields. The addition of irrigation water, together with salts, wastes and other pollutants, to the soil, may cause drastic changes in the regime and balance of water and solutes in the soil profile. Modelling may be useful to predict those changes, and therefore to guide the selection of practices and systems of drainage and irrigation for a maximum efficiency in the use of irrigation water, reducing the possibilities of losses and contamination of surface and ground waters, and preventing at the same time the processes of soil salinization and soil pollution. Those models must integrate parameters of climate, crops, soils, fertilization, use of pesticides and wastes, quality of irrigation water and of irrigation and drainage management. Following this approach there is presented and proposed a process based flexible modelling system, based on the balance of water and solutes in the soil, which has been developed through successive approximations and validations under very different conditions. The proposed model may be used to calculate the irrigation and drainage requirements in order to control the salinity and sodicity levels in soils and drainage effluents, in relation to requirements and availability of irrigation water, for specific crops, soils and climates. This enables to deduce alternative irrigation and drainage management practices for salinity and sodicity control, under changing physical, social and economic conditions, especially considering the increasing concern about environmental issues, climate change, direct competition of water of good quality for urban areas, industries and recreation, and the increased use of residual waters for irrigation. There are presented examples where this model is compared with other presently used or proposed models to predict salinization, generally with more empirical approaches.