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Physicochemical quality index for agricultural soils based on fuzzy logic

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This work proposes a new index for the evaluation of the dynamic quality of agricultural soils from a physicochemical point of view ($SDQI_{PHYS-CHEM}$). It was designed according to a previously developed methodology based on fuzzy logic. It allows the assessment of the physicochemical changes induced in the soil by its use and/or management as well as by pollution. The information required to design the $SDQI_{PHYS-CHEM}$ was obtained from a panel of experts in the different aspects related to the quality under assessment and their ecological implications. An environmentalist board coordinated the panel and the acquisition, management and treatment of the information during each stage of the procedure. Conventional convergence methods were used to achieve a joint opinion at every stage, which rigorously integrates and represent the contributions of the panelists. First, according to the methodology, the set of physical and chemical properties or attributes (a_i) included in the index was set. Then, conventional indicators (I_i) were selected to quantify each ai and the range of values $[\min I_i, \max I_i]$ of each Ii was established. Subsequently, the fuzzy sets B_i were defined for each property a_i, which describe in fuzzy terms the beneficial contribution of ai to the $SDQI_{PHYS-CHEM}$. Next, the relative importance of the properties was estimated. For this, a normalized priority vector $W' = \{w'_1,\ldots, w'_i, \ldots, w'_n\}$ was determined, so that each component w'_i represents the relative significance of attribute a_i in the $SDQI_{PHYS-CHEM}$ - represented as a fraction of unity. Finally, a set of fuzzy rules was defined in order to describe the knowledge base of the $SDQI_{PHYS-CHEM}$. Each rule gives the relation between a set of fuzzy values of the properties a_i - one value for each variable - and the value of the SQI_{BIO} corresponding to that physicochemical status of the soil. This index was validated in some agricultural parcels previously defined by the panel as being of low, medium and high physicochemical quality. The value of the $SDQI_{PHYS-CHEM}$ ranges from 0 to 1, the quality being higher the closer the value of the index is to 1.

Biography

Roberto Peche, Doctor of Chemistry is a Senior Lecturer at the Department of Environmental and Chemical Engineering of the University of the Basque Country (Spain). He lectures in the Industrial Chemical Engineering Degree Program. His main research experience is related to environmental technologies and the treatment of environmental information by fuzzy logic. He has participated in diverse research projects and has published a number of full papers in prestigious international scientific magazines.

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Page 64