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Assessment of the Impacts of Rice Cropping through a Soil Quality Index

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In Entre Ríos (Argentina), rice cultivation is carried out mainly in Vertisols. Several factors, such as the use of sodium bicarbonate waters for irrigation, the excessive tillage required, and the lack of proper planning for land use, mainly regarding the crop sequence, cause serious impacts on the soil and have an effect on sustainable agriculture. Thus, the development of methodologies to detect these impacts has become a priority. The aim of this study was to standardize soil quality indicators (SQI) and integrate them into an index to evaluate the impacts of the rice production system on soil, at the farm scale. The study was conducted in farms of the traditional rice cultivation area of Entre Ríos province, Argentina. We evaluated a minimum data set consisting of six indicators: structural stability and percolation, total organic matter content (TOM), exchangeable sodium content (ESC), electrical conductivity of saturation extract (ECe) and reaction of the soil (pH). From a database from 75 production lots, we determined the reference values, i.e. limits to ensure the maintenance of long-term productivity and the allowable thresholds for each indicator. The indicators were standardized and integrated into a soil quality index. Five ranges of soil quality were established: very low, low, moderate, high and very high, depending on the values assigned to each SQI. This index allowed differentiating the impact of different crop sequences and showed that the increased participation of rice crop in the rotation resulted in a deterioration of the soil structure due to the decrease in the TOM and to the cumulative increase in ESC caused by the sodium bicarbonate water used for irrigation. Soil management strategies should aim to increase TOM values and to reduce the input of sodium to the exchange complex. A rotation with 50% to 60% of pasture and 40 to 50% of agriculture with a participation of rice lower than 20 to 25% would allow the sustainability of the production system. The use of the so called SQI, i.e. soil quality index, for rice crop production will allow generating early warning of degradation and thus adopting recovery measures.