Adaptation of the Phosphorus Index to irrigated areas in the middle Ebro Basin. Las Filadas watershed case study (Huesca, Spain)

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In semi-arid irrigation areas, one of the most important surface water quality problems is nutrient pollution from agriculture through irrigation return flows, which can lead to their eutrophication. The element that most frequently limits the growth of aquatic vegetation is phosphorus (P) that may cause eutrophication above certain thresholds. Several management models for phosphorus diffuse pollution by agriculture are available currently, some of which resort to the use of indices. An index of phosphorus risk loss (PI) is a (usually) numerical value that weighs in a qualitative way the risk of water pollution by P associated to the farming practices and the soil and meteorological conditions of a zone. For that purpose, a PI must account for and integrate the processes involved in P availability and P transport. In this work, a new PI (called IPreg) has been developed for the irrigated area within "Las Filadas" gully watershed (Huesca, Spain), with a total 4920 ha and included in the water users associations of Orillena, Lanaja and Lalueza of the *Riegos del Alto Aragón* Irrigation Scheme. The original PI developed by Lemunyon and Gilbert **(**1993) has been adapted to irrigated farming systems of the middle valley of the Ebro (IPreg) introducing two new transport factors related to the irrigation management: (1) the Seasonal Irrigation Performance Index (SIPI) (Faci et al., 2000) and (2) the efficiency of the mean irrigation dose that represent average water loses below the root zone when an average irrigation dose was applied. Altogether, the IPreg includes 9 factors: three of which account for the P availability in the soil and six for the P transport processes. Results indicate that four percent (216 ha) of the study area showed High to Very High risk of phosphorus loss and 44 % (2315 ha) Medium risk. There was no significant difference between the IPreg mean values in the three water users associations in the study area. Corn and alfalfa showed the highest IPreg values for all parcels in the study area, as a result of the high water irrigation volumes served and the excessive phosphorus fertilization. Also, parcels on which organic fertilizers (especially pig slurry) were used showed a higher IPreg than the others and phosphorus-rich soils presented an IPreg superior to the rest. Finally, the IPreg can be used as a tool to 1) identify irrigated agriculture areas that may present a greater risk of P loss and thus guide more detailed research work towards them, 2) to promote farmers sensibility about implementing conservation measures and 3) to assist policy makers in the definition of priority actions within the environmental programs for sustainable agriculture.

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