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Assessing nitrate leaching losses with simulation scenarios and model based fertiliser recommendations

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Excessive mineral nitrogen fertiliser application and irrigation in intensive agricultural cropping systems is seen as a major reason for low water and nitrogen use efficiencies in the North China Plain. High nitrogen fertiliser and irrigation water inputs do not only lead to higher production costs but also to decreasing ground water tables, nitrate accumulation in deeper soil layers below the root zone and water pollution. To evaluate the effects of improved management practices on environmental pollution risk, the HERMES model is used to simulate nitrate leaching losses. The HERMES model is a dynamic, process based crop model made for practical applications such as fertiliser recommendations. The model was tested and validated on two field studies in the south of the Hebei Province that lasted for about three years with a winter wheat (Triticum aestivum L.) and summer maize (Zea mays L.) double cropping system. Biomass, grain yield, plant N uptake and soil water content were better simulated than mineral nitrogen in the soil. A model based nitrogen fertiliser recommendation was applied in the field for one wheat crop. The parallel model simulation showed satisfying results. Although there was no change in the amount of irrigation, the results indicated a possibility to reduce the fertiliser rate and thus nitrogen leaching even more than in the reduced treatment without reducing crop yields. Further more a simulation scenario with a model based fertiliser recommendation and a field capacity based irrigation was compared to farmers practice and reduced nitrogen treatment. The scenario results showed that the model recommendation together with the reduced irrigation has the highest potential to reduce nitrate leaching. The results also showed that flood irrigation as practiced by the farmers and its difficult to estimate amounts of water bears a big uncertainty for modelling.