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Effect of irrigation return flow on groundwater recharge in an overexploited aquifer in Bangladesh

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Irrigated agriculture has an important role in the food production to ensure food security of Bangladesh that is home to over 150 million people. However, overexploitation of groundwater for irrigation, particularly during the dry season, causes groundwater-level decline in areas where abstraction is high and surface geology inhibits direct recharge to underlying shallow aquifer. This is causing a number of potential adverse socio-economic, hydrogeological, and environmental problems in Bangladesh. Alluvial aquifers are primarily recharged during monsoon season from rainfall and surface sources. However, return flow from groundwater-fed irrigation can recharge during the dry months. Quantification of the effect of return flow from irrigation in the groundwater system is currently unclear but thought to be important to ensure sustainable management of the overexploited aquifer. The objective of the study is to investigate the effect of irrigation return flow on groundwater recharge in the north-western part of Bangladesh, also known as Barind Tract. A semi-physically based distributed water balance model (WetSpass-M) is used to simulate spatially distributed monthly groundwater recharge. Results show that, groundwater abstraction for irrigation in the study area has increased steadily over the last 29 years. During the monsoon season, local precipitation is the controlling factor of groundwater recharge; however, there is no trend in groundwater recharge during that period. During the dry season, however, irrigation return-flow plays a major role in recharging the aquifer in the irrigated area compared to local precipitation. Therefore, during the dry season, mean seasonal groundwater recharge has increased and almost doubled over the last 29 years as a result of increased abstraction for irrigation. The increase in groundwater recharge during dry season has however no significant effect in the improvement of groundwater levels. The relation between groundwater depth and groundwater recharge shows that the groundwater depth is continuously increasing with a little response to groundwater recharge. Groundwater abstraction for irrigation is not sustainable. Hence, more detailed studies on the effect of different irrigation scenarios on the groundwater system are recommended to strategize sustainable management of overexploited aquifer in Bangladesh.