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Estimation of groundwater contribution in runoff from small agricultural dominated catchments

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Under poor natural drainage condition, agricultural land has to be provided with subsurface drainage systems to discharge excess water from the rootzone, thereby guaranteeing optimal cropping conditions during the growing season, while in addition facilitating land preparation. Subsurface drainage systems can significantly contribute in runoff and nutrient loss generation. A secondary effect of drainage systems is that it reduces surface runoff and thereby erosion and phosphorus loss. In addition to surface and subsurface runoff, a third component, being groundwater, is contributing in runoff. As only information about the total runoff at the catchment outlet is available, uncertainty exists about the contribution of the different flow processes. Agriculture is a main contributor of nutrients and sediments to surface water causing water quality problems. Knowledge about the different pathways of water and hence nutrients and sediments to open water systems is important with respect to the choice of mitigation measures in agricultural dominated catchments. Estimates of groundwater or baseflow contribution (BFI) are often based on the use of digital filters applied to average daily discharge values. When using recommended values for the digital filter, this resulted in BFI of 40 - 50 % when applied to small Norwegian agricultural catchments. When taking the poor natural drainage conditions into consideration in addition to the presence of heavy marine clay deposits at depths greater than 1 - 2 m below soil surface, these values are considered unrealistically high. Deelstra et al (2010) showed that small agricultural catchments can have rather "flashy" runoff behaviour, characterised by large diurnal variations in discharge which also contradicts high baseflow contributions. An approach to obtain a realistic filter parameter for a digital filter has been carried out, based on discharge measurements on a set of small, nested catchments in Norway and further tested in Latvia. Each set consisted of a field providing both surface and subsurface runoff located within the catchment. Different filters were tested but the one developed by Chapman & Maxwell (1996) was selected. An improved filter parameter value was obtained, resulting in more realistic values for BFI in Norwegian catchments, being in the order of 10%. The values for the Latvian catchments were slightly higher, the main reason for this being soil types and geological settings. The results indicate that care should be taken in selecting the digital filter value for catchments having flashy runoff behaviour. This might lead to wrong estimates of baseflow contribution which can have negative effects on modelling hydrology, pollutant transport and the selection of mitigation measures at the scale of small agricultural catchments.

References

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