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# Modelling the effects of agroforestry systems on erosion, phosphorus loss and water balance in a small cultivated loess catchment

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The demand for renewable resources is growing steadily. With an expansion of energy crop cultivation, in particular the cultivation of corn, the negative effects of land use intensification increase. Corn growing requires large amounts of fertilizers and pesticides and, moreover, is highly susceptible to soil erosion by its late sowing and broad row distances. Soil erosion leads to a reduction of natural soil fertility and productivity. Furthermore aquatic ecosystems are threatened by the emission of sediments and associated nutrients and contaminants. Recent studies have shown that agroforestry systems, which combine areas of perennial woody plants and arable land, have the potential to protect soil and surface water bodies. They reduce erosion, runoff and leaching, thus improving the environmental quality in agricultural landscapes.
The aim of this study was to assess the effects of different agroforestry systems in a cultivated area, which is strongly affected by erosion. Study area was the 3.5 $km^2$ Weiherbach catchment, which is located in an intensively farmed loess landscape in southwest Germany. Using the process based model CATFLOW-SED, that allows the simulation of water and sediment transport, we designed several scenarios to quantify the effects of alley cropping, short rotation coppice and riparian buffer strips on erosion and runoff at the hillslope and catchment scale. We also investigated the effects of short rotation coppice on water balance. On the slope scale we examined alley cropping systems, riparian buffer strips and a short rotation coppice (SRC) on the upper slope part covering 5-11 % of the area. In comparison to a cultivation of corn in monoculture, erosion was decreased by 14 to 46 % in the agroforestry scenarios. It was shown that the efficiency of agroforestry systems to protect soil and surface water bodies is not only controlled by the percentage of woody plants but is particularly dependent on their location. We found that, although riparian buffer strips reduce surface runoff and sediment delivery to surface waters, they offer no erosion control at the source areas of sediment production. The strongest protection against erosion was achieved by the short rotation coppice, which showed superior over the alley cropping systems and riparian buffer strips. On the catchment scale scenarios of short rotation coppice were implemented covering 2 %, 10% and 20% of the area. In comparison to the erosion rates observed for the given land use pattern and a heavy storm event, the modeling results showed a reduction of 3 – 68 % for the different scenarios. Furthermore modeling results for a period of 18 months represent that the negative effects of a large scale short rotation coppice cultivation on the water balance as described by other authors do not apply for the study site.