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Nitrogen Losses by Erosion and Leaching in Hillside Cropping Systems of Northeast Thailand as Affected by Soil Conservation Measures: A Case Study

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Abstract

In Northeast Thailand, soil erosion by water is a severe problem in uplands. High amounts of fertiliser are required to compensate for nutrient losses by runoff and to mitigate soil degradation. Nitrogen losses by soil erosion are main contributors to environmental problems. Both, applying integrated soil conservation systems as well as studying the dynamics of nitrogen losses are needed to provide sustainable agriculture. The objectives of this study were to assess (i) nitrogen losses by erosion and leaching in hillside cropping systems and (ii) effects of soil conservation measures on these losses. Data were collected from an erosion trial on a clayey, kaolinitic, typic Papyrusloam during 2003 and 2004 at Ban Bo Muang Noi, Northeast Thailand, with slope gradients ranging from 18–25%. The field trial was established in a split plot design with two replicates. Two fertiliser levels (no fertiliser and 61 kg of N and 14 kg P ha⁻¹) were applied in the main plots, while four soil conservation measures with maize and a control were established in the subplots. The treatments were (i) farmers' practice, (ii) vetiver grass strips, (iii) mango-grass hedges, (iv) leucaena hedges and (v) papaya-grass hedges. Soil loss in the farmers' practice was significantly higher than in all other treatments and amounted to 20.4 t ha⁻¹ yr⁻¹. The lowest soil loss was observed with papaya-grass hedges with less than 5.4 t ha⁻¹ yr⁻¹. Runoff losses did not differ significantly among treatments, but tended to decrease when soil conservation measures were applied. Comparing leaching and soil losses showed that leaching was the main pathway of N losses. N losses by erosion accounted for only 9–32% of the total N losses, whereas leaching accounted for 68 to 91%. In soil conservation treatments, however, leaching losses were 12% higher compared to the farmers' control. In conclusion, soil conservation measures involving papaya-grass barriers controlled soil loss, runoff and nitrogen loss by erosion in maize effectively, but led to higher N losses via leaching due to an increased infiltration rate when compared to farmers' practice.

Keywords: Agroforestry, erosion, fertiliser application, fruit trees, leaching, maize, N losses, runoff, ruzi grass, soil conservation, soil loss, vetiver grass