Soil conservation: hoax or blessing - recent experiences from Southeast Asia

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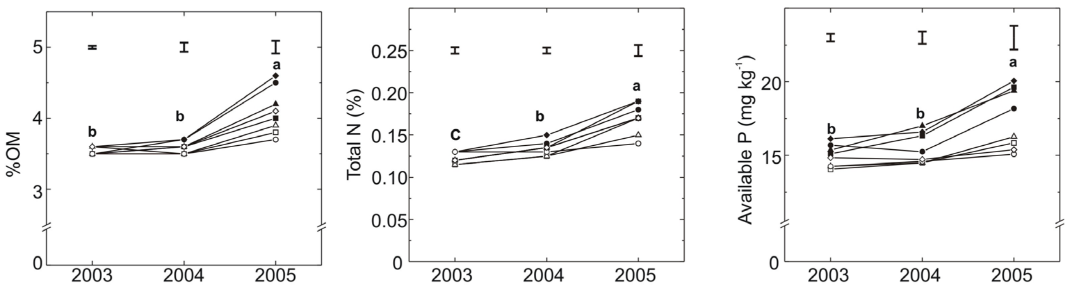
The debate on soil conservation is old. Various concepts have been proposed during the past decades but were hardly adopted by farmers. Erosion is, thus, still a severe threat to agriculture, food security and people's livelihood. Main causes are population pressure, deforestation, shifting from traditional swidden to more permanent cropping, people's encroachment on steep slopes associated with agricultural activities, growing demand for crops with poor soil cover such as maize, and improper crop management (Turkelboom et al. 2008). Consequences are soil loss, runoff, and soil degradation at plot level, sedimentation of water bodies, landslides in susceptible areas, and flooding at landscape level (Schmitter et al. 2011). Although causes and consequences are well known, land use planning and other regulatory approaches mitigating these risks had little success in the past. Farmers are reluctant to accept successful soil care measures, mostly due to underestimation of the problem's scope, and high opportunity costs in terms of land occupied by soil conservation measures, increased work load, and reduced yields (Giller et al. 2011; Saint-Macary et al. 2010).

The objective of this study was testing the effectiveness of soil conservation under contrasting conditions. In Thailand, one trial was established on a relatively fertile Lixisol, the other on a shallow Haplustult with high stone content, both with moderate slope gradients of 21-28%. In Vietnam both trials were established on Luvisols with a longer cropping history and slope gradients of up to 53%. Rainfall pattern was similar ranging from 1,000 to 1,300 mm per year. Treatments were selected based on local preferences, but had the following features in common: local farmer's practice, maize under minimum tillage with legume relay cropping, grass barriers or hedgerows.

Results showed that farmer's practice was always associated with high soil losses and runoff rates (soil loss: <24 t/ha on moderate slopes or <174 t/ha on steep slopes). When maize was grown under minimum tillage relay cropped with legumes, strong reductions of soil loss and runoff were observed, starting in the second or third year (soil loss: 2.5 t/ha). Results from both Vietnamese sites indicated that soil cover was of prime importance on steep slopes (soil loss of maize under minimum tillage/relay cropping: 5.3 t/ha). If the soil was well covered, then even rain storms with high intensities had little erosive effects, regardless if the soils were already saturated from previous rains.

Treatments with minimum tillage and legume relay crops showed positive yield responses of maize after the establishment phase (Lixisol: 3.2 vs. 5.5 t/ha, Luvisols: 3.9 vs. 4.4 t/ha). Simultaneous cropping of maize and cover crops, grass barriers and hedgerows controlled soil loss and runoff well but was associated with significant yield reductions. Maize chili intercropping tested at one Thai site is an interesting economic option but had little effect on controlling erosion. Hedgerows and grass barriers controlled soil loss well but led to decreases in maize yield (Lixisol: 3.2 vs. 2.7; Luvisols: 3.9 vs. 2.4 t/ha). At the Lixisol site, increases of chemical soil properties were observed in the course of time, even without fertilization due to minimum tillage and relay cropping (Figure 1). Similar but less strong trends were observed for both, the two Luvisols in Vietnam and the stone-rich Haplustult in Thailand.

In conclusion, minimum tillage with relay cropping showed positive effects on soil properties, erosion control and maize yields, even on steep slopes or stone rich and shallow soils. However, possible constraints to the adoption of this technology are yet to be assessed, especially in view of the fact that a minimum tillage system is in stark contrast to farmers' current practice.



Note: maize □ under minimum tillage and relay cropping, o with Ruzi grass barriers, Δ with Vetiver grass barriers, ◇ with leucaena hedges; open symbols: −F, filled symbols: + F; vertical bars show standard errors of the differences in mean, values followed by the same letter are not significantly different among years

Figure 1. Impact of soil conservation on OM, Total N and available P. Data were collected from the top soil of Lixisol in Thailand. Vertical bars show standard errors of the differences in mean. Values followed by the same letter are not significantly different among years.

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