Soil conservation by vegetative barriers in a maize cover crop system in northern Thailand

T. Kongkaew[1], D.E. Leihner[2] and N. Steinmüller[2]

1) Mae Hia Agric. Res. Station, Faculty of Agric., Chiang Mai University, Chiang Mai 50200, Thailand (Tkongkaew@hotmail.com)
2) Institute of Plant Production & Agroecology in the Tropics & Subtropics , University of Hohenheim, Germany (inst380@uni-hohenheim.de)

Problem

- In the mountainous area of northern Thailand, average soil losses amounted to 67 t ha^{-1} yr^{-1} during the past decade.
- Farmers, however, have rarely adopted soil conservation measures due to insufficient profitability and the large initial investments.

Objective

- To assess the sustainability and profitability of soil conservation measures on moderate slopes in the sub-humid zone of Thailand.

Methods

Soil loss and **runoff** were measured after each erosive rain (>10 mm) in 22 erosion plots (10 x 36 m, 21-36% slope) between March 1997 and March 1999 at Huai Luk, 100 km north of Chiang Mai (19° N, 99° E)

Treatments: (i) 2 fertiliser levels (0 and 61 kg ha^{-1} N + 13.9 kg ha^{-1} P), (ii) 5 cropping systems (Fig. 1) with 2 replications

Climate: tropical savannah climate, avg. temperature = 25 °C; annual rainfall = 1,354 mm in 1997 and 927 mm in 1998

Soil: Alfisol with a clay to clay loam texture, a pH-H_2O of 5.7 and low total N (0.17%), available P (5.4 mg kg^{-1}) and CEC (15 cmol$_c$ kg^{-1}) in the 15 cm topsoil

All **results are presented** for fertilised treatments (except Fig. 4) averaged across the three hedgerow systems (except Tab. 1) and two years (1997+1998).

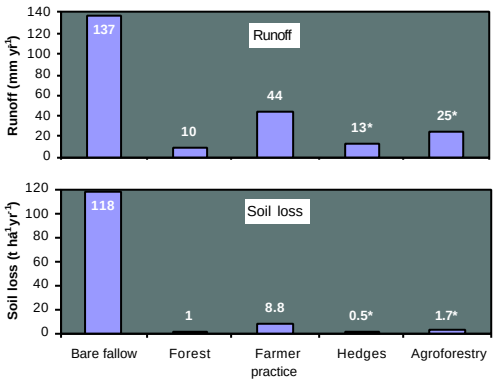
Farmer practice | ***Leucaena* hedges** | **Mango-grass hedges** | **Grass hedge** | **Mango agroforestry system**

Fig. 1. Five maize **cropping systems** with a relay crop of *Lablab purpureus* and a maize straw mulch. Three systems contained **contour hedgerows** (vegetative barriers) planted to (**i**) *Leucaena leucocephala*, (**ii**) mango and grass (*Paspalum notatum)* and (**iii**) pure grass (*Brachiaria ruziziensis).* Two treatments were **without barriers**: (**i**) farmer practice and (**ii**) agroforestry with mango tree rows. All tree or grass rows were 1 m wide and spaced 6 m apart.

Results

• Soil and water loss

All three **hedgerow systems** reduced runoff and soil loss to forest levels. Even the **improved farmer practice** with a lablab cover crop caused little runoff (4% of 1141 mm rainfall) and a soil loss below the tolerance threshold of 10-12 t ha^{-1} yr^{-1} (Fig. 1).



* significantly different from farmer practice in the mean of fertiliser treatments using a dunnett test (P<0.05)

Fig. 2. Runoff and soil loss in bare fallow, secondary forest, farmer practice, hedgerow and mango agroforestry plots.

2. Yields and profitability

Maize yielded about **3.5 t ha^{-1} yr^{-1}** grains in all five cropping systems. Mango tree systems produced 3-4-times more **net return to labour** than the farmer practice (Tab. 1).

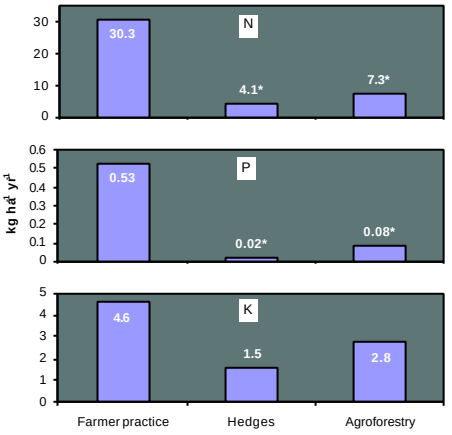
Tab. 1. Input costs, food crop yields and net returns from five cropping systems.

	Farmer practice	Leucaena hedge	Mango-grass hedge	Grass hedge	Mango agro-forestry
Input ($ ha^{-1})					
1. Labour[a]	453	510	592	470	623
2. Materials	179	122	122	122	134
Yield (kg ha^{-1})					
3. Mango	-	-	652	-	481
4. Maize	3878	3582	3538	3539	3339
Net return ($ ha^{-1})					
5. Total return[b]	388	358	**1006**	354	**815**
6. Net return[c]	-244	-273	**292**	-237	**57**
7. Net ret. to labour[d]	209	237	**884**	232	**680**

a) 3.2 US$/manday, b) using farm gate prices at harvest ; c) =5-(1+2); d) =5-2

3. Nutrient loss and recovery

Soil conservation with hedgerows and agroforestry reduced **N** and **P** more than **K losses,** because K runoff losses were not significantly reduced presumable due to K leaching from mulched crop residues (Fig. 3).



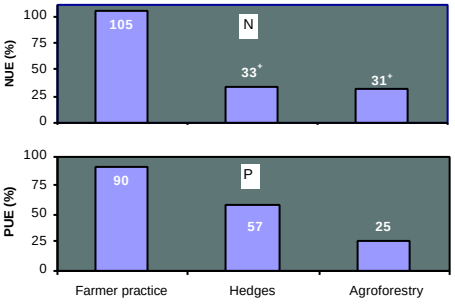
\+ significantly different from farmer practice (P<0.05) using a dunnett test; other effects: P> 0.1

Fig. 3. Total N, Bray-II P and exchangeable K losses.

Conclusions

- ⇒ The **improved farmer practice** of maize production with relay cropping of lablab is sustainable on moderate slopes (21-36%) in the subhumid tropics of northern Thailand.
- ⇒ **Contour hedgerows** reduce soil and water losses to forest levels and increase the profitability if fruit trees are included.
- ⇒ The total **value of nutrient conservation** in the mean of the three fertilised hedgerow treatments as compared to the farmer practice amounted to 31 US$ ha^{-1} yr^{-1}.

All soil conservation measures reduced the N and P **fertiliser recovery** (Fig. 4) by increasing biomass recycling at the expense of exports (data not shown).



\+ significantly different from farmer practice (P<0.1) using a dunnett test; other effects: P> 0.1

Fig. 4. Apparent N- and P-fertiliser use efficiency.

Aknowledgement
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Literature

Kongkaew T (2000) Yields and nutrient budgets of hillside cropping systems with erosion control in northern Thailand. Diss. Univ. Hohenheim, Verlag Grauer, Stuttgart.