The effect of reduced tillage on erosion in the North-West of Vietnam

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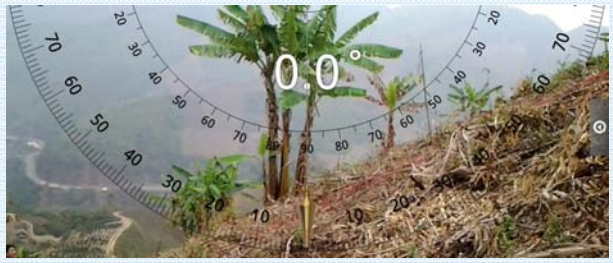
Introduction

Land use in the upland cropping regions of the mountainous regions of North-Western Vietnam is almost entirely maize production. The vast majority of farmers practice maize mono-cropping during the rainy season, fallow during the cool dry season. Land preparation is slash, burn and cultivate. This causes massive soil erosion at the onset of the rainy season. Soil loss rates of 350t/ha are not uncommon. Due to generally deep soils in the region, farmers currently compensate for soil loss easily through increased fertiliser application rates and improved, higher yielding varieties. Though, they do report that the rocks in their field are getting '*bigger*' due to erosion; but there is no motivation for practice change towards reducing soil erosion.

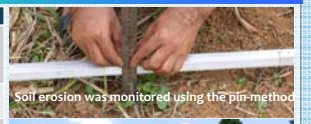
Herbicides are readily available and affordable by farmers. This suggested that reduced tillage may offer a cost effective and labour saving alternative to cultivation, and reduce soil erosion.

We investigated the effect of reduced tillage and no tillage on soil erosion at two sites near Moc Chau and Son La.



Methods

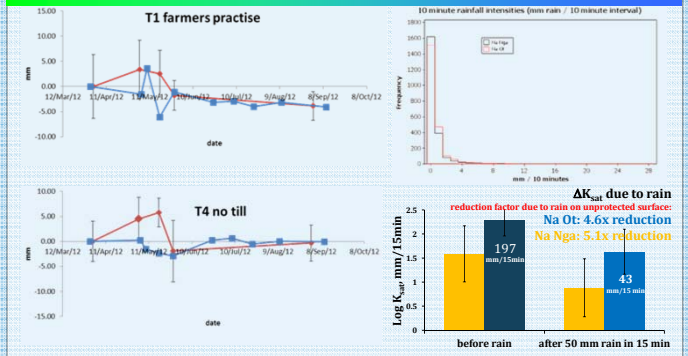
Son La - Na Ot	Moc Chau - La Nga	Comments
(i) Control	(iv) Control	The normal farmer practice was slash and burn before cultivation. But in 2011 the farmer at La Nga decided not to burn. Due to animal grazing in La Nga, mulch was imported in 2011.
(ii) Minimum Tillage	(ii) Minimum Tillage	Residue retained, cultivation of one row where maize was sown
	(iii) Minimum Tillage, rice bean intercrop	Different row spacing but same plant density. Rice bean did not grow in 2011 and 2012, hence this treatment in La Nga is the same as Minimum Tillage except for the different row spacing.
(iii) Mini-terraces		Build in 2011 and reshaped in 2012 and 2103, residue retained.
(iv) No-tillage	(i) No tillage	Residue retained and maize planted in small hole.
No free grazing	Free grazing	Due to the difference in animal management between sites, the La Nga site was fenced off in years 2012 and 13.


Soil erosion was monitored using the pin-method


In 2013 erosion barriers were installed to visualise soil erosion by spray painting the barriers with different colours at different times

Ground cover (%, digital beaded string), changes in ground cover biomass over time (t/ha), Infiltration rates (K_{sat}, falling head method), rain fall intensity (loggers) and Agronomic data was also collected.

Results



The erosion pins (blue line) showed considerable soil movement at the start of the growing season. Later in the season, the soil surface levels changes measured corresponded to slumping due to bulk density increases (red line). This relationship was less obvious in the control, indicating greater soil movement due to cultivation.

However, the pin method, corrected for soils slumping, was not able to show significant differences in erosion rates if soil cover was maintained. This was unexpected as ground cover under reduced tillage at the start of the season ranged from 70-90% (3 – 5 t/ha) whilst in the control is was reduced to around 10% (<1 t/ha).

Further, although there was a ~5-fold reduction in K_{sat} due to raindrop impact on bare surface, the K_{sat} rates remained larger then rainstorm intensity. To corroborate this findings of high erosion, unaffected by surface cover and high infiltration rates, we installed the erosion barriers, but only in year 2013 and at the Na Nga site.

The erosion barriers confirmed that maintaining ground cover through reduced tillage had little effect in reducing erosion on these steep slopes. **This does not mean that maintaining ground cover is irrelevant, but it clearly shows that maintaining ground cover is not the *'silver bullet'* to manage erosion.**

Treatment	Station	Block 1	Block 2	Block 3
(i) Control (slash—burn—cultivate)	Top			
	Bottom			n/a—*stolen*
(ii) Min-tillage	Top			
	Bottom		n/a—*stolen*	
(iii) Mini-terrace	Top			
	Bottom			n/a—*stolen*
(iv) Zero-tillage	Top			
	Bottom			

Blue paint applied 7th May, planting

yellow paint applied 7th July, tillering

Red paint applied 9th September , harvest

Blue strip: Deposition between planting and tillering

Yellow strip: Deposition between tillering and harvest

Conclusion

- Soil erosion cannot be controlled through maintaining ground cover
- Erosion occurs despite high infiltration rates:
  - Is erosion due to concentrated water delivery into the uncovered part of soil surface?
  - Is water delivery by individual raindrops greater that the soils ability to take up water?
  - Is there ex-filtration on theses steep slopes?
- There is little, if any incentive for farmers to adopt soil conservation practises - even though farmers are well aware of erosion: It is impossible *not* to see it!
- Maize should not be grown on theses steep slopes

Questions that require Answers

- What are the incentives for farmers, and how can incentives be established, to foster adoption of soil conservation practises?
- What are the steepest slopes where maize production is possible?
- What are the threshold slopes for different soil management practises on what soils for maize production?
- What are alternative land uses on slopes where maize should not be grown?
  - Given the expansion into Coffee: is this an option?
  - Is temperate fruit an option?
  - Are hedgerows with '*cut-and-carry*' an option where animals are kept?

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