Utilising basic soil data for the sustainable management of upland soils in Vietnam and Australia

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Typically the productivity of crops grown on upland soils in south-east Asia with subsistence agricultural practices is low, and this is due to a variety of soil constraints. These constraints may comprise one or more of: nutrient (nitrogen, phosphorus and potassium) deficiencies, aluminium toxicity, calcium deficiency, surface sealing, water stagnation and compaction. Much soil information (profile morphology, characterisation analyses) is collected during soil surveys and research activities, but this is often not used for any other purpose than to classify soil types. Soil map is very useful for scientific purpose but is not a friendly tool to farmers. Yet the interpretation of this information is critical for identifying the particular soil constraints limiting long term productive potential (i.e soil capability for sustainable production) for any crop/soil type combination. Therefore there is a need for using full potential of this information by defining soil constraints at the catchment scale and by developing soil management practices consistent with long term productivity at village/block scale. This will be achieved by using a simple decision support framework to synthesise existing knowledge into real world applications.

This approach has been demonstrated in two focus provinces – Gia Lai and Binh Thuan. Basic soil information existing in both provinces was used to develop appropriate management practices. The field trial treatments were designed to ameliorate the constraints identified by the SCAMP assessment of the soils at the field sites.

The Dak Po district of Gia Lai has been newly created by separation from the An Khe district. This offers a significant opportunity for SCAMP to assist local agricultural staff to improve their recommendations on better management practices for the district. While the soils are generally described as Acrisols, the transect has shown variations in soil attributes that affect management. The SCAMP-trained extensionists from Dak Po are now aware of such constraints in these soils as compaction, surface sealing, surface runoff, aggregation/segregation, soil acidity, Al toxicity, and low nutrient retention. One of the treatments in the Acrisol demonstration trial was mounding up of the planting row with crop residues (mostly of low nutrient stems) to produce more aeration and to increase water infiltration into the soil. It is expected that this practice will soon be wide spread.

As a result from soil survey and evaluation, Ferralsols in Gia Lai province have a high P-fixing capacity therefore proper application of phosphate fertiliser (both P source and application timing) will improve soil productivity for small holders growing annual crops. Green manure incorporation was used as a means of reducing Al toxicity and improving nutrient retention capacity. As farmers often used blended fertilizers such as 16-16-8-13, this practice creates problems for timing application of fertilizers and nutrient supply, especially slow- released phosphate fertilizer. Due to a long weathering process, the Ferralsols in the province have a very low ECEC which affects the nutrient holding and

supplying capacity. Treatment descriptions, grain yields and benefit/cost ratios obtained in the field trials are presented in Table 1 and Table 2.

Table 1. The effect of suggested treatments on grain yield and benefit/cost value of a maize crop grown on a Ferralsol of Iakha village, Gia Lai province in 2005

Treatment	**Grain Yield (T/ha)**	**Benefit/Cost**
1. Farmer's practice (71N, 21P, 20K, 39S)	0.2 d	0.4
2. High P recommendation (115N, 57P, 140K)	1.8 bc	1.3
3. Bentonite @ 5T/ha (115N, 42P, 140K)	2.3 ab	1.4
4. *Tithonia* @ 10 kgP/ha incorporated (115N, 42P, 140K)	2.3 ab	1.3
5. *Tithonia* + bentonite (115N, 42P, 140K)	2.8 a	1.3
6. Dispersed P (115N, 42P, 140K)	1.4 c	1.1
7. Banded P (115N, 42P, 140K)	1.6 c	1.2

Table 2. The effect of suggested treatments on grain yield and benefit/cost value of a maize crop grown on a Ferralsol of Iakha village, Gia Lai province in 2006

Treatment	**Grain Yield (T/ha)**	**Benefit/Cost**
1. Farmer's practice (71N, 21P, 20K, 39S)	1.1 d	1.6
2. High P recommendation (115N, 57P, 140K)	4.4 ab	3.2
3. Bentonite @ 5T/ha (115N, 42P, 140K)	4.2 b	2.5
4. *Tithonia* @ 10 kgP/ha incorporated (115N, 42P, 140K)	4.7 a	2.3
5. *Tithonia* + bentonite (115N, 42P, 140K)	4.4 a	1.3
6. Dispersed P (115N, 42P, 140K)	3.8 bc	3.0
7. Banded P (115N, 42P, 140K)	3.8 c	3.0

30%N, 40%K, 100%P at planting
30%N, 20%K 30 DAS

In summary, the following results were obtained:

- The use of 'straight' fertilisers rather than the blended mixtures used by the farmers in the 'farmer practice' allowed a correct balance of N, P and K to be obtained. Generally the blended fertiliser rates used in 'farmer practice' were lower than the district recommendations, but even when the N rate applied in 'farmer practice' approached the district recommendation, there was insufficient P and K being applied to meet crop demands.
- Incorporation of high activity clay (bentonite) into the planting row improved yield in both soils. In the Ferralsol, the effect was associated with an increase in ECEC and therefore K retention, while in the Acrisol, it was probably associated with an increase in soil water holding capacity.
- Green manure crops such as *Tithonia, Mucuna* and *Pueraria* were all shown to have beneficial effects on both soil types. In particular, application of *Tithonia* to the Ferralsol increased soil pH, reduced Al toxicity, increased P availability and provided N. The main effects of application of *Mucuna* and *Pueraria* appeared to be enhanced N supply.