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Potential tree-crop combinations for conservation agriculture with trees in Vietnam

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In Vietnam, evidence of environmental harm caused by conventional (intensive) agriculture with the recent extension of monocropping has been reported (Curtis 2012; Wood et al. 2006). At the same time, agricultural production is required to increase further. Conservation agriculture (CA) and agroforestry practices have high potential to improve farm productivity and profitability. However, scaling up of CA remains a major challenge for small-scale farmers, and agroforestry approaches to maintaining soil fertility have met with limited success, especially where poverty and hunger force farmers to use desperate, short-term survival strategies that take precedence over longer-term sustainability.

CA and agroforestry have often been viewed as independent approaches. Scientists at ICRAF are working on 'conservation agriculture with trees' (CAWT), an approach that would add to a fourth principle to CA -that of tree-crop integration- and meet the short-term needs of small-scale farmers for food and income, while contributing towards sustainable resource management.

Maximising the synergic effects of trees and crops requires knowledge of selecting species combinations and of good management of trees and crops, such as increasing the supply of nutrients to the crop, supplying N from tree roots to crop roots, long-term effects on erosion, soil organic matter content and soil compaction (van Noordwijk et al. 2011), and minimising the competition between them. In reality, the empirical assessment of tree-crop combinations is laborious, costly and time consuming. The use of modelling tools, such as WaNuLCAS (Water, Nutrient and Light Capture in Agroforestry Systems; van Noordwijk and Lusiana 1999), provides a good starting point, as it can simulate tree-crop interactions in agroforestry. WaNuLCAS is based on the above- and below-ground architecture of trees and crops, elementary tree and crop physiology and soil science. It can be used to assess the profitability and sustainability of various agroforestry systems.

To assess the potential agroforestry systems that can complement CA practices in Vietnam, a collaborative study was implemented with partners in three universities in Vietnam, namely Hue University, Tay Nguyen University and Nong Lam University, as well as the Northern Mountainous Agriculture and Forestry Science Institute (NOMAFSI). We used WaNulCAS to compare potential agroforestry systems that can complement CA in Vietnam, assessing carbon stocks, yields and greenhouse gas (GHG) emissions. We compared 3 systems: intercropping cassava (*Manihot esculenta*) in an *Acacia mangium* plantation in the first year of establishment in Phu Tho province; intercropping cassava and groundnut in a rubber plantation in Hue province; and intercropping cassava in a *Litsea glutinosa* plantation in Gia Lai province. These tree and crop components are commonly planted by farmers, and give good economic returns and environmental protection. Data used in the WaNuLCAS model were parameterised from and calibrated against existing practices. The model can simulate different management options based on spacing, fertilisation, irrigation practices and pruning regimes.

During the first 2 years, integrating cassava into rubber could improve the economic effectiveness (through cassava sales), accumulate more carbon, reduce GHG emissions (N_2O, NH_4) and provide cash benefits to farmers. Intercropping rubber with cassava or groundnut in the third year is less viable because of above-ground competition between trees and crop.

Farmers who intercrop *Litsea* and cassava usually plant cassava every 2 years in the first 4 years, yet the simulation showed that they can intercrop it every year without adversely affecting the growth of *Litsea*. Farmers who continue to intercrop cassava in the first 4 years will thereby increase their income. The economic and environmental benefits of the system would increase when CA practices such as mulching are included (cassava residues can be left on the soil surface), and further still with the use of inorganic fertiliser.

At the current planting density of 3 m x 2 m, acacia produces the highest biomass in the second year (2.5 kg/m^2). When the trees and cassava are spaced at 5 m x 2 m, the total biomass of the system is 5 kg/m^2, although the biomass of acacia is only 1.8 kg/m^2. Intercropping cassava with acacia is optimal only in the first 2 years.

Although we did not consider monocrop systems, we posit that integrating trees with crops has greater and multiple system benefits, which can be enhanced when combined with CA practices. We therefore recommend CAWT to achieve higher economic returns and environmental protection in Phu Tho, Hue and Gia Lai provinces, Vietnam.

Keywords

Agroforestry, WaNuLCAS, CAWT, ICRAF

References

Curtis M. 2012. Conventional farming or sustainable agriculture. ActionAid.

van Noordwijk M, Lusiana B. 1999. WaNuLCAS, a model of water, nutrient and light capture in agroforestry systems. Agroforestry Systems 43: 217–242.

van Noordwijk M, Lusiana B, Khasanah N, Mulia R. 2011. WaNuLCAS version 4.0. Background on a model of water nutrient and light capture in agroforestry systems. ICRAF (World Agroforestry Center), Bogor, Indonesia.

Wood R et al. 2006. A comparative study of some environmental impacts of conventional and organic farming in Australia. Agricultural Systems 89(2–3): 324–348.

Bibliography

Blanco-Canqui H, Lal R. 2009. Principles of soil conservation and management. Springer.

Mendonca ML. 2001. Monocropping for agrofuels: the case of Brazil. Development 54(1): 98–103.