ROOTS AS PART OF THE CARBON AND NITROGEN INPUT AND OUTPUT OF THREE TYPES OF CROPPING SYSTEMS ON AN ULTISOL IN NORTH LAMPUNG

Kurniatun Hairiah[1)], Meine van Noordwijk[2)] and Georg Cadisch[3)]

[1)]Fac. of Agriculture, Brawijaya University, Malang, Indonesia;

[2)] ICRAF SE Asia, Bogor, Indonesia;

[3)] Wye College, Univ. of London, UK;

ABSTRACT

Yields of annual food crops typically decline with time after conversion of forest (fallows) in the humid tropics, along with a declining soil organic matter content. Application of organic matter particularly in combination with inorganic fertilizers, may maintain a high crop production. However, the availability of organic materials such as (green) manure or crop residues is limited, while fertilizer use is often not within the financial possibilities of small farmers. Understanding the dynamics of C and N in such systems may help to understand the options for soil management. Three types of cropping systems were evaluated in 1994-1996 in Lampung i.e. cassava-based intercropping, hedgerow intercropping and legume cover crop rotations. The purpose of this presentation is (a) to quantify C-input and output from above ground and below ground of different cropping systems, (b) to measure a productivity index of different cropping systems as indicator of sustainability. In the cassava-based systems (CS 1 and 2) much more C was removed (6 Mg ha^{-1} year^{-1}) than in the other systems, while the amount returned to the soil was much smaller than in the other cropping systems. About 0.5 - 4.5 Mg ha^{-1} was returned to the plot as litter fall, green leaf and roots of cassava (CS1), and maize + rice residues (CS2) and about 5 - 7 Mg ha^{-1} has been transported out of the plot (as tuber and stems). The hedgerow intercropping (CS 3 and 4) gave a positive balance, as about 4.5 Mg ha^{-1} was returned to the plot as biomass pruning and crop residues and about 1.5 Mg ha^{-1} was removed out of plot as yield. The cover crop rotation (CS 5 and 6) gave a surplus C about 4 Mg ha^{-1} where 2 Mg ha^{-1} of C was returned to the plot as crop residues plus *Mucuna* (only the 2nd year) and Cowpea biomass, and about 1.1 Mg ha^{-1} was transported out plot. The hedgerow intercropping systems (CS 3 and 4) gave an N input of about 25 kg ha^{-1} year^{-1} returned to the soil, the balance was 55-60 kg ha^{-1} year^{-1} for the cover crop rotation systems (CS 4 and 5). The cassava based (CS 1 and 2) systems gave the highest negative N budget was about 200-275 kg ha^{-1} year^{-1} was removed out of the plot. This calculation on C and N budget may help to explain the decline of cassava yield during 3 years of cropping after slashing and burning the forest. The addition of N via N_2-fixation of leguminous was excluded from this calculation. Rice showed the highest C input (shoot + roots) about 3.5 Mg ha^{-1} year^{-1}.compared to *Flemingia*, mix *Peltophorum+GlirIcidia* and maize which gave input of about 2.75, 37.5, 0.6 Mg ha^{-1} year^{-1}. Roots as part of C input to soil contributes about 20 %, 37 %, 55% and 65 % for *Flemingia*, mix *Peltophorum+Gliricidia* , rice and maize, respectively The cassava monoculture and hedgerow intercropping systems showed the index of productivity (I_p index) was below 1.0, indicating that yields were insufficient. The cowpea grown in CS6 contributed more to the I_p than groundnuts, as it gave a good yield in two out of three years. This experiment provides further evidence for the trade-off between short term profitability and longer term sustainability of food crop production systems under these conditions. The intensive grain legume – cereal rotations at moderate fertilizer input levels appear to provide the best compromise.

Proc. Seminar Toward Sustainable Agriculture in Humid Tropics Facing 21st Century: 86 - 95
Bandar Lampung, Indonesia, September 27 – 28, 1999