Tropentag, September 16-18, 2015, Berlin, Germany

"Management of land use systems for enhanced food security: conflicts, controversies and resolutions"

Productivity Evaluation of Maize Based Cropping Systems on Tropical Hillside Agriculture with Soil Conservation Options

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Abstract

In future, agriculture have to produce more food from less area to meet demands of growing population through efficient use of natural resources with minimal impact on the environment. Intercropping and agroforestry systems are important land uses to sustain tropical hillside agriculture. In a field trial with 20–25 % slope located in western Thailand, we evaluated production sustainability of maize based cropping systems, i.e. monocropping vs. intercropping and hedgerow systems; +/-fertiliser application; tillage vs. minimum tillage plus legume relay cropping.We used above ground biomass (AGB) production, electrical resistivity tomography (ERT), Carbon stable isotope (δ^{13}C), light use efficiency (LUE) and land equivalent ratio (LER) to evaluate maizebased cropping systems. Water Nutrient and Light Capture in Agroforestry Systems (WaNuLCAS) was also used to identify sustainable production options for investigated cropping systems. Maize AGB production (1365g m^{-2}) was highest in maize-chili intercropping with fertilisation, minimum tillage and maize chilli intercropping with hedgerow system (1250g m^{-2}) than in current farmers' practice of maize monocropping (control). ERTmeasurements and δ^{13}C showed highest soil moisture in maize chilli intercropping with hedgerow system. LUE for AGB was 1.44–1.56 g DM MJ^{-1} in fertilised intercropping and hedgerow systems, being 17–27 % higher than in the control. With fertilisation, LER of maize-chili intercropping (1.03–1.17) and hedgerow intercropping (1.21) was higher than that of the control. Hedges had a negative impact on maize closely planted maize rows due to nutrient limitation. WaNuLCAS simulations also indicated nutrient limitation between hedges and closely planted maize rows. Overall, maize chilli intercropping and hedgerows systems with fertilisations were favourable for exploiting available resources increasing biomass production of maize and chilli with higher AGB, LUE and LER in contrast to maize monocropping. Model suggested that small targeted additional N and P dressings to maize in rows close to hedges helped overcoming nutrient limitation and maintained production sustainability of maize based agroforestry system. Such crop management options are doable by local farmers and may foster future adaptation of soil conservation. Productivity evaluation showed that inclusion of hedgerows and intercropping in tropical hillside agriculture is promising in enhancing crop production and food security.

Keywords: Agroforestry, intercroping, LER, maize, Thailand, WaNuLCAS

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