

1.5 MAIZE YIELD AND PROFIT INCREASE UNDER A NO-TILLAGE SYSTEM AND CROP ROTATION WITH LEGUMES IN SOUTHERN SAYABOURY PROVINCE, LAO PDR

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Context

Sayaboury province is currently the main maize production area in the Lao PDR. Due to high demand for maize from local traders, most farmers grow maize in monocultures covering more than 42,000 ha in southern Sayaboury province, amounting to more than 80% of the total rainfed cultivated area. This market-oriented agriculture is also characterized by the expansion of intensive agriculture based on heavy mechanized tillage, the increasing use of herbicides and hybrid seeds. Although smallholders have rapidly generated large profits with maize production, and despite the fact that some fairly productive soils remain, they tend to be rather vulnerable due to the rapid depletion of the “natural capital” through this “mining” agriculture.

In light of that, and since 2003, the Lao National Agro-Ecology Programme (PRONAE) has been developing and adapting direct seeding mulch-based cropping (DMC) systems, setting up several experimental sites and taking a participatory approach involving village communities and farmer groups.

Objectives of the study

This study attempted to compare agronomic and economic performances between conventional tillage and DMC cropping systems.

Materials and methods

Since 2004, experimental criss-cross trials have been carried out in southern Sayaboury province (Kenthao, Paklay and Boten districts) where yield and economic components - production costs, labour force, and gross income - have been recorded yearly. A range of DMC systems were set up integrating local species (i.e. maize, rice bean) as a first step. Each cropping sequence, and each year of the sequence, was represented under no-tillage and conventional tillage (reference) practices. The cropping sequences compared were i) maize monocropping, ii) a two-year rotational sequence of maize - rice bean and iii) a two year rotational sequence of maize + *B. ruziziensis* - rice bean.

Results

Maize yield

In a maize monocropping sequence, differences between maize yields under conventional tillage and no till were not significant and the mean yield - without fertilizer - only reached 50 to 60% of potential yield. On the other hand, the maize yield recorded under no-till with a former rice bean crop (two-year sequence of maize - rice bean and maize/*Brachiaria ruziziensis*) was 50% higher compared to a maize monocrop and was close to the maize potential yield. Under tillage and no-tillage, wide fluctuations in maize yield in a monocropping sequence could occur depending on climatic conditions, while maize yields with a rice bean as the former crop appeared to be less affected by drought conditions.

Labour force

The labour force required for maize cultivation - maize monocropping - under conventional tillage and no till was fairly similar (mean of 60 days/ha). For both systems, weeding after maize seeding was necessary due to strong weed pressure. In contrast, with a former rice-bean crop, weed-related constraints were lessened because of the cover crop composed of rice bean residues, which prevented weeds from developing.

Production costs

Production costs related to maize monocropping under tillage could reach 250 USD/ha. With no till, production costs could be reduced by at least 50%. In the case of the monocropping sequence (tillage and no till), pesticides were used because of an increase in weed pressure and a large quantity of mineral fertilizers needed to be used yearly to balance mineral element exportation and maintain a minimum productivity level, while input costs tended to increase rapidly in line with the rise in oil prices.

In contrast, production costs related to the cultivation of maize seeded on rice bean residues (two-year sequence of maize - rice bean and maize/*Brachiaria ruziziensis*) were lower because less herbicide was required for land preparation and weeding during the maize cycle due to efficient weed control by the plant cover.

Net income

In comparison with maize monocropping under conventional tillage, the net income generated by maize production increased from 30% (maize monocropping) up to 100% (two-year sequence of maize - rice bean and maize/*Brachiaria ruziziensis*). Furthermore, the net income generated by maize production with rice bean as the former crop under DMC - without fertilizer - was distinctly higher than that generated by maize monocropping with fertilizer (60 N - 60 P₂O₅ - 60 K₂O).

Finally, the two-year sequence of maize - rice bean and maize/*Brachiaria ruziziensis* (for both species) generated respectively a gain of 70% compared to maize monocropping with conventional tillage and 35% compared to maize monocropping under DMC.

Conclusion

Maize monocropping, under conventional tillage and/or no-tillage, is not a sustainable cropping system because of 1) the increase in weed pressure, 2) low plant matter production (above and below ground) which prevents rapid structural improvement of the soil and 3) the need for frequent chemical inputs. A two year sequence such as maize - rice bean and maize/*Brachiaria ruziziensis* can rapidly improve the physical, chemical and biological characteristics of the soil and generate higher profits for smallholders, while protecting soils and restoring their fertility. However, organic systems should be progressively integrated into DMC systems in order to ensure sustainable and environmentally-friendly agriculture.