Developing Conservation Agriculture Production Systems in the Philippines

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Introduction

Uplands in tropical countries face high erosion rates brought about by intense cultivation and heavy rainfall. This largely contributes to the decline in crop productivity and to the increase use of farm fertilizers to produce same amount of farm output. Conservation agriculture with trees (CAT) offers solution to this pressing problem through following 5 key principles: Minimum soil disturbance, continuous mulch, maintaining diverse crop species, integrated pests and nutrient management. CAT is very important in soil and water conservation, enhancing agri-diversity, improving farm carbon sequestration potential, maximization of land area usage in the Philippines as well as the reversal of soil degradation thus improving food and nutritional security of the upland dwellers.

Figure 1. Degraded agricultural landscapes are expanding in the Philippines due to improper tillage and water –induced soil erosion on sloping lands causing low farm productivity, malnutrition and poverty

Objectives

The objective is to assess crop yields from conservation agriculture production system (CAPS) and to compare them from conventional plow-based system in the Philippines.

Methodology

Five promising conservation agriculture production systems (CAPS) were evaluated in comparison with conventional maize tillage system (Table 1) in Claveria, Misamis, Philippines (8°38'39", 124°55'49") on a sloping land of 26%. Two weeks before planting, the weeds were sprayed with glyphosate (Round up) following the standard recommendation rate. Treatments 1-4 used dibble method in planting maize seeds as well as the associated crops. All treatments were subjected to low (F1 = 0-30-0 $NP_2O_5K_2O$) and moderate (F2 = 60-30-30 $NP_2O_5K_2O$) fertility levels. Due to poor performance of F1 during the first year, it was modified to high fertility level with 120-60-60 $NP_2O_5K_2O$, during the subsequent year. All P and K were applied as basal. N was applied in split at 15 and 30 days after emergence. Turn around period was reduced by immediately planting the crop after each harvest except with treatments having a fallow period (T2).

Treatment	Description
T1 - Maize + *Arachis pintoi*	Maize seeds were dibble planted using stick spaced at 70 cm x 20 cm making 72,000 plants per hectare. The *Arachis pintoi* cuttings were planted single row in the middle of maize rows spaced at 25 meters apart.
T2 - Maize + Stylosanthes – Stylosanthes fallow	The maize was established and managed similar to T1. The *Stylosanthes guianensis* seeds were drilled in between rows of maize and thinned 10-15 plants per linear meter.
T3 - Maize + Cowpea – Upland rice + Cowpea	The maize was established in double rows at 35 cm spacing and 20 cm between plants making 72,000 plants per hectare followed by 2 rows of cowpea at 35 cm spacing with 10-15 plants per linear meter. After cowpea harvest, upland rice was subsequently planted. After maize harvest, cowpea was subsequently planted.
T4 - Maize + Rice bean	The maize was established similar to T1. Rice bean was established 2 weeks prior to maize harvest.
T5 - Cassava + Stylosanthes	Furrows were spaced at 100 cm and cassava cuttings were planted 50 cm apart making 20,000 plants per hectare. *Stylosanthes guianensis* seeds were drilled in between rows of cassava and thinned 10-15 plants per linear meter.
T6 - Maize – Maize (conventional plow base)	Two plowings using animal drawn mould board plow; two harrowing using animal drawn spike-toothed harrow, and furrowed by animal drawn mould board plow.

Figure 2. Conservation agriculture with tree (CAT) with principles of minimal soil disturbance, continuous ground cover, diverse crop species, integrated pests and nutrients management and integration of trees provides alternative option.

Results and Discussions

Cassava plus *Stylosanthes guianensis* and conventional maize systems had higher total system productivity compared to other CAPS (Figure 3) during the first year (2010). Maize with cowpea followed by upland rice with cowpea yielded the lowest due to very close spacing between rows at 30 cm. The moderate fertility level (60-30-30) had higher yield across all CAPS compared to low fertility level (0-30-0) (data not shown).

In year 2011, Cassava + stylo had the highest total system productivity (Figure 3) which constitutes cassava roots and stems and 3 prunnings of stylo. It was followed by maize + *Arachis pintoi* and maize + stylo rank third. The remaining CAPS were comparable in total system productivity. The conventional maize system did not outyield the other CAPS as observed during the first year (2010).

***Stylosanthes* grown in cassava as well as in maize yielded significantly better than *Arachis pintoi* planted in maize (Figure 4). *A. pintoi* is usually slow during establishment. Stylosanthes grown in cassava resulted to greater yield partly because cassava plants did not shade the forage grass faster than in maize allowing the grass to grow better**

Interplanting maize and cowpea provided higher sales due to relatively higher price of cowpea beans even having lower total system productivity (Figure 4)

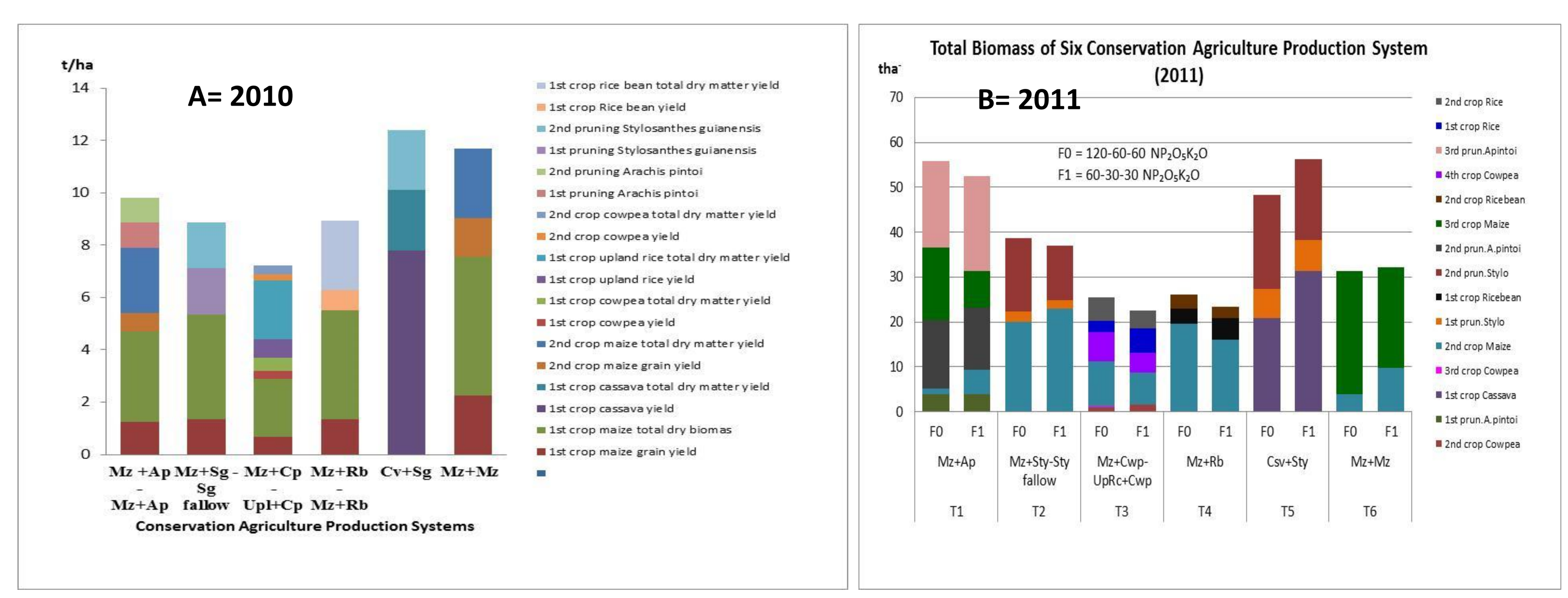

Figure 3. Total system productivity of five CAPS and maize monocropping system during year 1 (A- 2010) and in year 3 (B-2012) . Claveria, Misamis Oriental, Philippines.

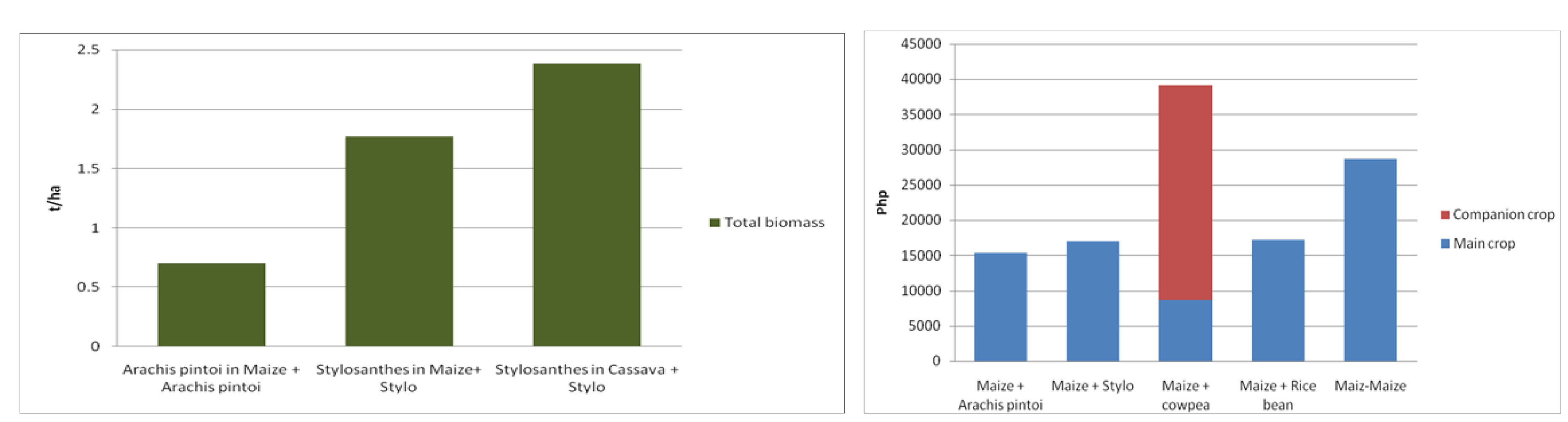

Figure 4. Productivity of forage legumes under different CAPS (A) and partial gross income of CAPS (Maize price at P13/kilo; Cowpea at P50/kilo) (b). Claveria, Misamis Oriental, Philippines

Conclusion

We found out that Cassava + Stylo showed higher total system productivity across all CAPS treatments. Maize + *Arachis pintoi* showed higher total biomass and grain yield among CAPS treatments with maize in the subsequent year. This might be due to higher N-fixing capacity of *Arachis pintoi* that supplemented additional N to the soil which was used both maize and the legume. Conventional maize monocropping system productivity declines on the subsequent year

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