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Economical evaluations on conservation agriculture cropping systems during a 6-year-study on maize cash-crop cropping system in Xayabury Province, Lao PDR.

The Southern part of Xayabury Province of Laos, measuring about 5,000 km², is characterized by an oriented production area mainly for maize (*Zea mays*) as a cash-crop to the neighbouring Thai market for more than 20 years. From 2003 to 2008 a research-development project promoting conservation agriculture (CA) technologies was conducted in order to prevent negative externalities such as soil erosion and pesticides run-off. This project called *PRONAE* realized continuous household surveys, on-farm trials and located research-managed experiments by developing strong links with farmer organizations, extension services, maize traders and provincial authorities. At the end of the project about 3,000 ha were identified to be conducted with CA principles. In this case, this associated no-tillage and minimum crop residue conservation at sowing time. This could be done with improved technologies including appropriate direct-sowing machines for 2 and 4-wheel tractors, as well as hand-sowing planters and local tools. We reported in this paper results on surveys and experiments mainly focusing on economic evaluation during a 6-year study on three contrasted areas concerning their maize intensification potential. We also wanted to explore the specific role of diversification for future CA extensions. Surveys (Slaats and Lestrelin, 2009) and showed that the level of conservation agriculture household adoption at the end of the project (2008) was 46% in the poorest area concerning the initial soil fertility status (sandstone parent material) and only 8% in the highest soil fertility area (shale parent material). The intermediate soil fertility area (basic igneous parent material) showed a 26% level of household adoption. Also, soil fertility levels were related to mechanization use. The lowest fertility area was also shown to have a greater extension of steep slopes compromising 4-wheel tractor use. Without surprise this area was shown to have lower demographic pressure, lower household rain-fed surface areas and lower total income revenues. This area showed greatest crop diversification. The most of legumes, rice-bean (*Vigna umbellata*), has been grown in sole crops as well as intercropping. It also could be developed for forage, local consumption and commerce. Rice-bean could give the same level of profit as maize in terms of net revenue and this crop showed an ability to control invasive weeds in permanent cropping systems. On-farm trials over a 6-year period did not show any significant year trend even with maize grain yields when comparing both conventional (CV) and CA maize monocropping, 4,233 and 4,362 kg/ha, respectively. Despite this, economic data revealed that CA cropping systems strongly and significantly reduced production costs of maize cultivation and increased net incomes obtained per hectare, respectively, -44% and +39%, compared with CV. Labour input did not show significant differences among the 2 major cropping systems. Maize grain yields obtained on research-managed experiments (Hoa et al., 2008) over 4 years confirmed the previously recorded data that mono-cropping with tillage or no-tillage did not offer any significant yield difference. Nevertheless the introduction of rice-bean in a 2-year rotation with maize improved maize grain yields significantly by 25%. Our results confirmed that CA cropping could improve economic short term efficiency. Diversification and specifically legume integration in the case of cereal based cropping systems are one of the keys to agro-ecological efficiency during crop succession. Successful CA experiments had been performed as maize and rice-bean relay inter-cropping, that provided higher income as there were two harvests per year. For that legume market access should be improved because it showed great year variation concerning Thai traders demand.

Table 1. Surveys data.

Maize intensification potential areas (District reference)	Main parent material	Geomorphology	Mechanization	Total income (2004-2007)	level of Ca adoption in 2008	Demographic density (hb/km² in 2005)	Rural extra-activities (2004-2007 income)	Average surfaces of rainfed crops (2005-2008)	% legumes of rainfed crop area (2005)
Low (Boten)	Sandstone rock	Slopy and hilly	Low and heavy	Medium	46%	16	40	1.5 - 2.5 ha	23
Medium (Kenthao)	Igneous basic rock	Hilly and slopy	Heavy	High	28%	26	25	2.5 - 4 ha	9
High Paklay	Shale rock	Gently hills	Heavy	Very high	8%	29	15	2.5 - 3 ha	0

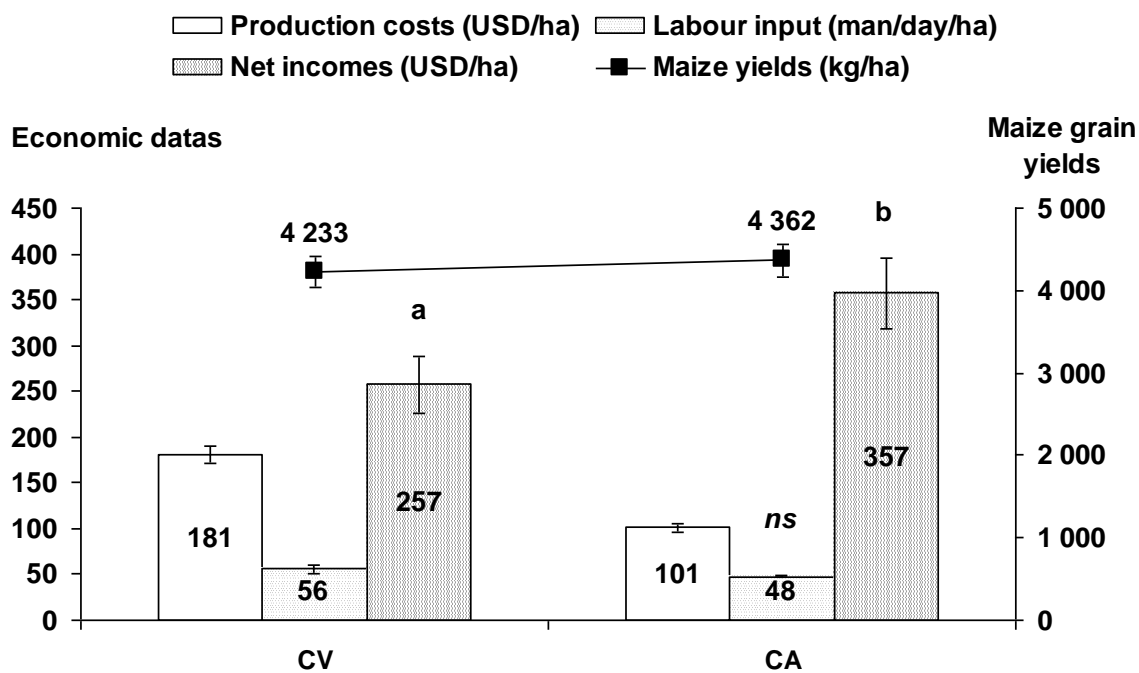


Figure 1. Mean economic data obtained on on-farm trials during 2003 to 2008 comparing conventional (CV) and conservation agriculture (CA) cropping systems with maize monocropping without fertilization; 2 villages for both Kenthao and Paklay districts.

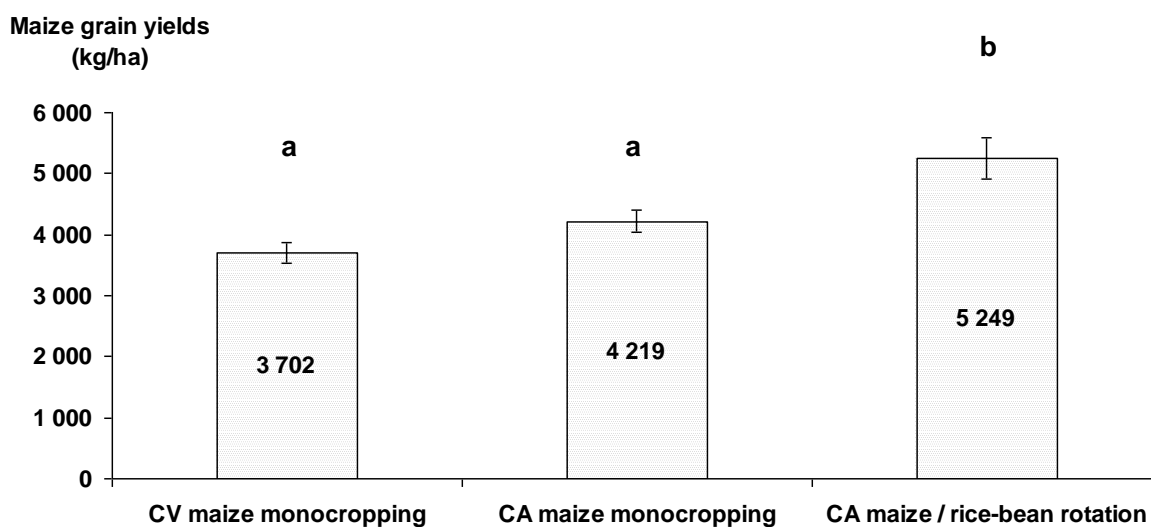


Figure 2. Mean maize yields on research managed experiments during 2005 to 2008 comparing conventional (CV) maize monocropping, conservation agriculture (CA) maize monocropping systems and CA maize/rice-bean 2-year rotation; 1 site for Boten, 2 sites for Khentao and 1 site for Paklay