



## Productivity and profitability of manual and mechanized smallholder conservation agriculture (CA) systems in Eastern Zambia

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### Abstract

Climate variability and declining soil fertility pose a major threat to sustainable agronomic and economic growth in Zambia. In general, southern Africa has increasingly experienced poor rainfall distributions, in-season dry spells, lasting 18-33 days and low rainfall amounts (<400 to 650 per annum) in the current decade, resulting in low production or complete crop failure. The objective of this study was to identify land- and labour productivity enhancing technologies that are more resilient to climate variability through adaptive research in Eastern Zambia. The economic analysis was based on on-farm trials which lasted from 2012-2015. Farmers in target areas were replicates of a randomized complete block design. Net return ha<sup>-1</sup> was estimated for each maize and legume yield observation (kg ha<sup>-1</sup>) produced by each seeding technology (i.e. conventional ridge tillage, CA dibble stick planting, CA animal traction ripping and direct seeding), based on the domestic maize price and the variable costs of each technology. The dibble stick, ripline and direct seeding CA systems had 6-18%, 12-28% and 8-9% greater maize yield response relative to the conventional tillage system, respectively. Rotation of maize with cowpea and soybean significantly increased maize yields in all CA systems. Intercropping maize with cowpea increased land productivity (e.g. the land equivalent ratio for 4 seasons was 2.01) compared with full rotation of two crops under CA. Gross margin analysis from 2012-2015 of manual cropping system showed that intercropping of maize with cowpea using dibble stick produced the highest net returns ha<sup>-1</sup> of between US\$312.64 - US\$767.76 as compared to US\$204.95 – US\$657.94 for dibble stick maize-cowpea rotation; US\$108.53 – US\$584.70 for dibble stick maize monoculture; and US\$64.22–US\$ 516.06 for the conventional ridge and furrow maize monoculture. The net-return for the mechanized animal traction system showed that maize-soybean rotations using the ripper for planting was more profitable than the cultivation with an animal-drawn direct seeder or conventional ridge and furrow. The study clearly shows that cropping systems based on the principles of CA were more profitable and resilient to climate variability. Their economic benefits as well as good agronomic practices therefore have the potential to improve food security and agricultural productivity for smallholder farmers in eastern Zambia.

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