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THIRD AFRICA CONGRESS ON CONSERVATION AGRICULTURE
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Comparison of mechanized Conservation Agriculture and conventional disc-harrowing based on a three-year on-farm experiment in Zambia

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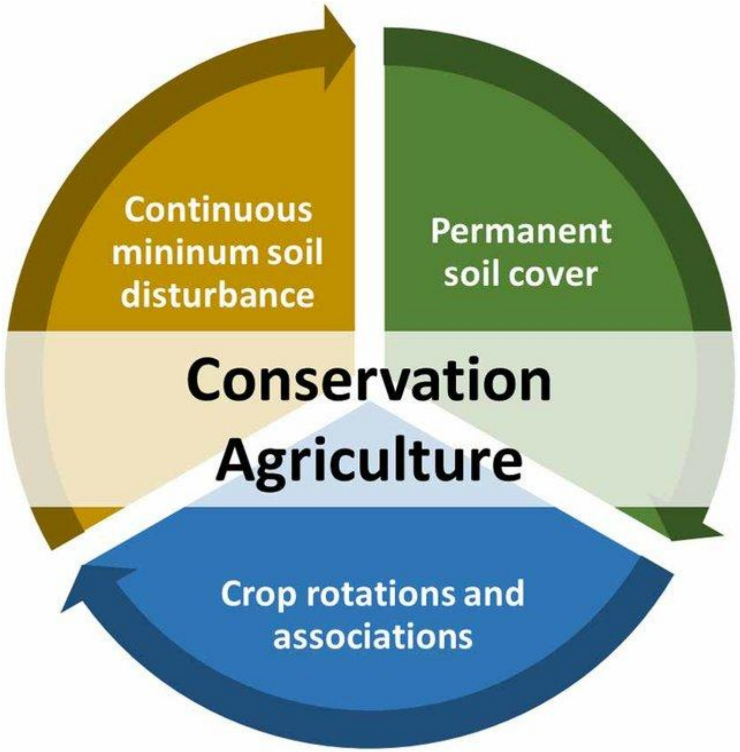
Theme:
Building a Resilient Future in Africa through Conservation Agriculture and Sustainable Mechanization

Background

- Low mechanization & unsustainable agricultural practices – causes of poor yields and degradation of soils
- Conservation Agriculture (CA) has emerged as a candidate for sustainable agricultural practice
- CA – an ecosystem friendly farming practice – spread worldwide but slow adoption rate in SSA countries
- Zambia: second-largest farm area under CA in SSA - **14.41%**
- CA extremely labor intensive among small-scale farmers



Source: Calegari et al. (2020)

Sources: Thierfelder et al. (2017) Lalani et al. (2016); Mupangwa et al. (2017); Stevenson et al. (2014); Mkomwa et al. (2021)

Rationale

- Recent readjustments in farming and land ownership systems across SSA & in Zambia
  - Rise of medium-scale – cultivating 5-100 ha and market-oriented, so called "Emergent Farmers" (EFs)
- EFs' use some level of mechanization e.g., animal draft power (ADP) or tractors
  - EFs presents a new perspective for CA
- Synergy: CA – mechanization – rise of EFs, to upscale CA adoption and productivity in Zambia?

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Are emerging farmers the missing link for mechanised Conservation agriculture? Viewpoints from Zambia

Godfrey Omulo, Thomas Daum, Karlheinz Köller & Regina Birner

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Research gap & objective

- Mechanization may incentivize CA adoption in SSA, little research has focused on the performance of mechanized CA using 4WTs (Mupangwa et al., 2019)

Source: aviddemand.com

Aim

- Investigate to what extent and how sustainable agricultural mechanization can unlock the potential of CA, focusing on medium-scale farmers in Zambia
  - short-term agronomic and socio-economic differences between mechanized conventional tillage and MCA

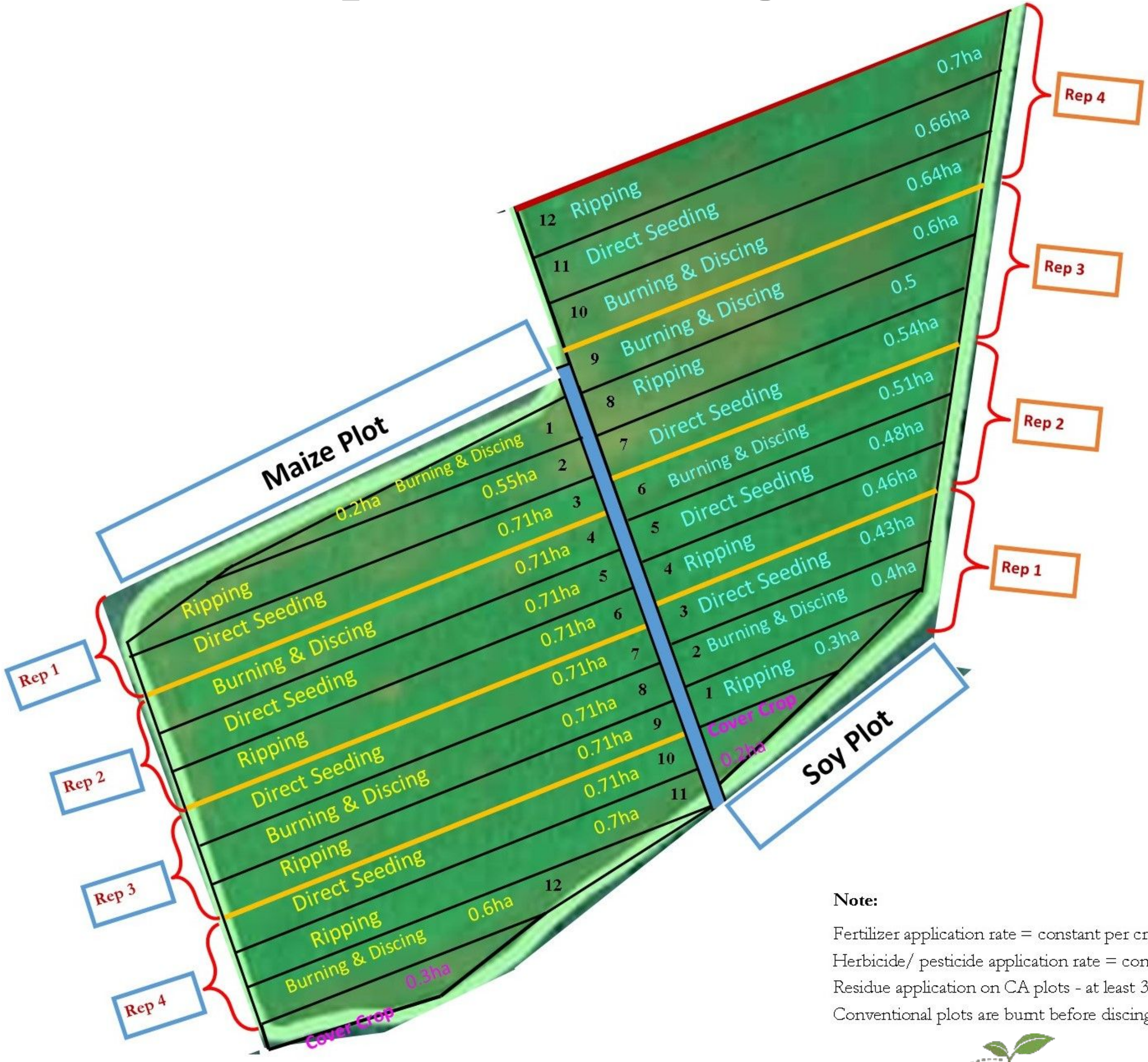
Materials and methods

Study site

- GART - Chisamba district central province
- Agroecological zone 2a – acidic soils
- Annual precipitation of approx. 700-1000 mm: Nov – April
- Plot fallow for 3 years

- 15 ha land – rainfed
- 3 treatments; CA: ripping & no-till; Conventional: discing + residue burning
- RCBD: 12 experimental units, 4 replicates
- Maize and soybeans rotated for 3 seasons
- Land preparation, seeding, fertilizer & herbicides application – 60hp tractor

Experimental design



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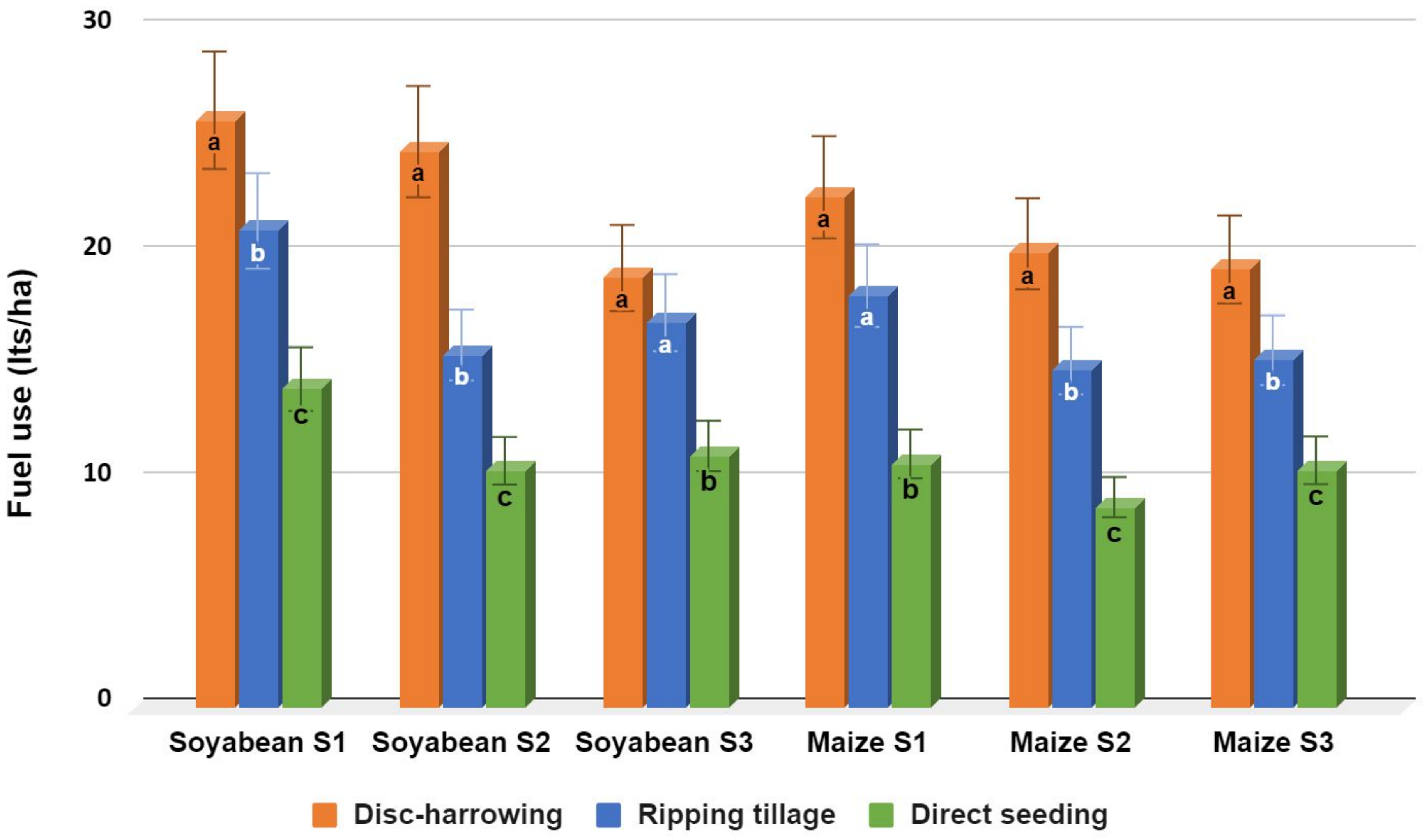
Findings

Effects of tillage on yield and rainfall-use efficiency (RUE)

Crop	Tillage	2019-2020		2020-2021		2021-2022	
		Yield (kg/ha)	RUE (kg/mmha-1)	Yield (kg/ha)	RUE (kg/mmha-1)	Yield (kg/ha)	RUE (kg/mmha-1)
Maize	Disc-harrowing	7792[a]	10.91	10688[b]	9.93	8250[a]	10.33
	Ripping tillage	7873[a]	11.03	10018[ab]	9.31	8361[a]	10.47
	Direct seeding	7802[a]	10.93	9751[a]	9.06	8241[a]	10.32
Soya	Disc-harrowing	2848[a]	3.99	2678[a]	2.49	2411[a]	3.02
	Ripping tillage	2992[ab]	4.19	2669[a]	2.48	2604[a]	3.26
	Direct seeding	3109[b]	4.35	2634[a]	2.45	2491[a]	3.12
Annual rainfall (mm)		714		1076.4		798.8	

Means followed by same letter are not significantly different at $p \leq 0.05$ according to F and Fisher's LSD tests.

Time and fuel use



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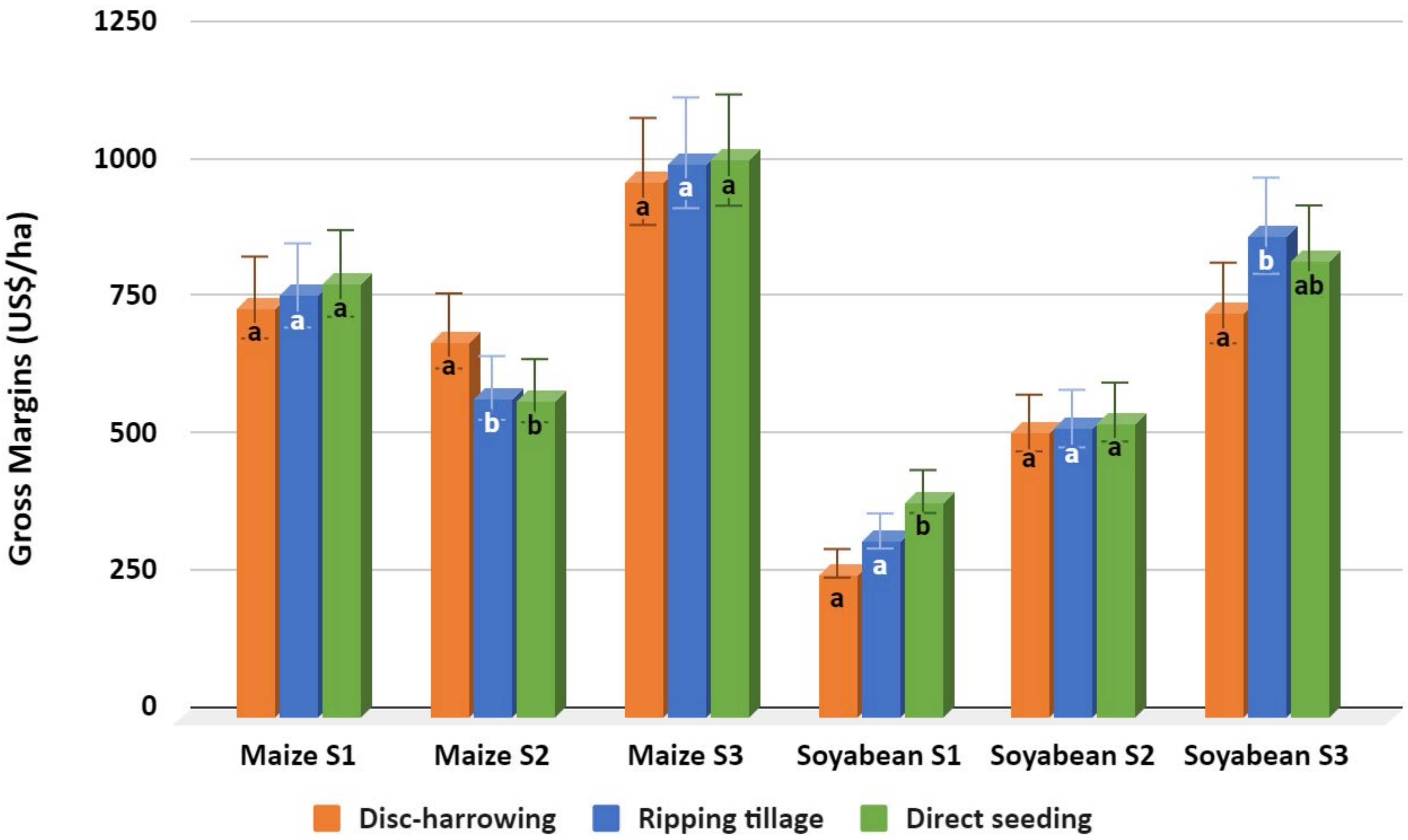
Hiring costs & Profitability



Conclusion

- MCA offers great opportunities for medium-scale farmers to ↑ productivity per unit area

- Time and fuel savings in MCA → non-farm activities and ↓ CO_2 emission footprint (Johansen et al., 2012; Pratibha et al., 2015)

- MCA can be profitable & economically viable in the short term and in drier seasons even if all machinery is hired (Umar, 2014)

- More research on the enabling environment for MCA, investment and appropriate policies is still needed – SSA & Zambia

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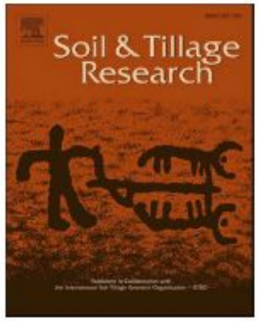

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Comparison of mechanized conservation agriculture and conventional tillage in Zambia: A short-term agronomic and economic analysis

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A R T I C L E I N F O

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Mechanized conservation agriculture
Disc-harrowing
Yield
Profitability
4WTs

A B S T R A C T

The rise of medium-scale farmers across sub-Saharan Africa (SSA) is offering Conservation agriculture (CA) a new perspective. Such farmers not only cultivate increasingly large land areas but also provide machinery services, share knowledge, and can act as role models to smallholders. Although mechanization may incentivize CA adoption in SSA, little research has focused on the performance of mechanized CA using four-wheel tractors (4WTs). This study explores the short-term agronomic and economic differences between mechanized conven-

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