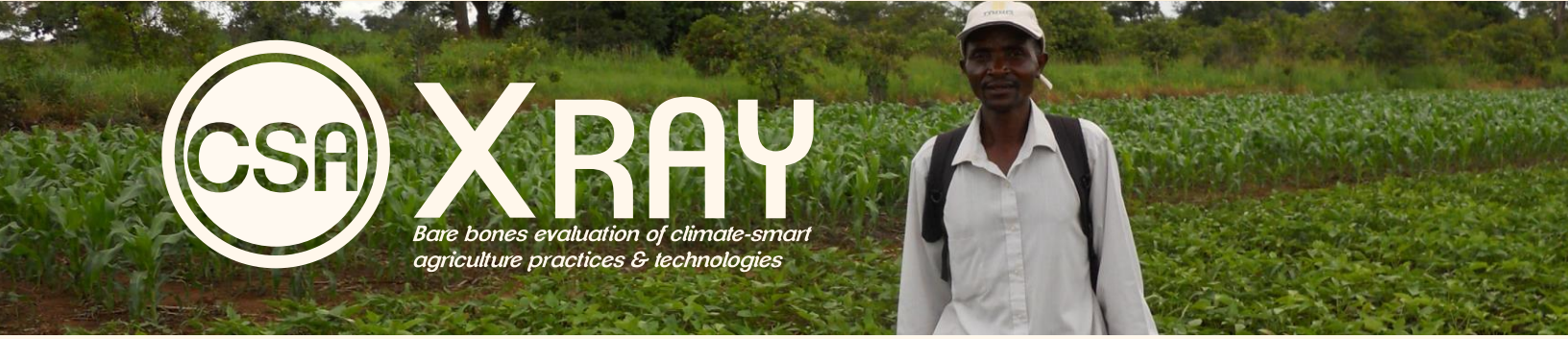


CONSERVATION AGRICULTURE IN EAST AND SOUTHERN AFRICA
MAIN MESSAGES

What is and what is not climate-smart agriculture (CSA)? That existential question sparks debate, complicates implementation and fractures the development community. CSA X-rays provide a detailed analysis of what science and scientists tell us about the 'climate-smartness' of proposed CSA interventions. Each section contains an infographic that illustrates the potential impact of the intervention on outcomes when changing practices[1].

Key messages for the CSA X-ray on Conservation Agriculture in East and Southern Africa are:

Productivity	Yield benefits from using conservation agriculture, by comparison to conventional systems, are typically positive in the literature from this region but vary depending both on the cropping system, year and site (ranging from -20 to 200%). Information on the impacts on income is sparse and shows a diversity of possible affects.
Resilience/ Adaptive Capacity	Most of the data available relates to impacts on the physical resilience of the systems such as changes in soils chemical properties and affects on drought and largely suggests that conservation agriculture improves these system properties. Much less is known about the impact of conservation agriculture on economic and social properties of the system. However, expert opinion and limited data indicates that there may be tradeoffs in terms of labor and gender concerns with conservation agriculture.
Mitigation	Conservation agriculture is unlikely to reduce greenhouse gas production or increase soil carbon stocks in East and Southern Africa with any of the many possible variations in implementation.
Climate Risks	Because of the positive affects on soil physical properties, conservation agriculture has potential to mitigate many of the precipitation and seasonal affects of climate change. In addition, the impact of rising temperatures may be mitigated to some degree due to soil cover.
The Business Case	Conservation agriculture performs poorly across indicators of system performance including negative net present value, cost benefit and with delayed returns on investment.
Scaling up	There has been relatively limited uptake of conservation in East and Southern Africa, with only 100,000 households or less predicted to be utilizing the practice in Zambia, Malawi or Zimbabwe, for example.
Barriers to adoption	The factors affecting adoption of conservation agriculture are inconsistent across studies. Many of factors have both positive and negative impacts depending on the study and few are universally influential in the same direction. Furthermore, most characteristic are only statistically significant in fewer than half of the studies except for ones such as income.

[1] X-rays were designed to print as either 4-page leaflets that include key messages and hints on interpretation or 2-page briefs.

CSA XRAY

Bare bones evaluation of climate-smart agriculture practices & technologies

CSA TECHNOLOGY

CONSERVATION AGRICULTURE (CA)

in East & Southern Africa

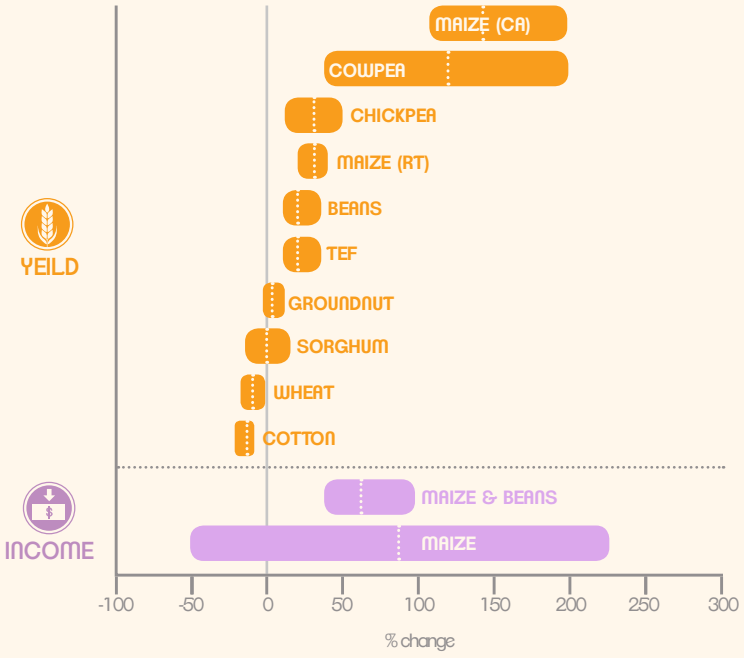
Combinations of minimal soil disturbance, crop rotations and maintaining soil cover

COMPONENT PRACTICES

LAND PREPARATION	AGROBIODIVERSITY	SOIL & WATER MANAGEMENT	NUTRIENT MANAGEMENT
Ploughing (p)	Local variety (lv)	Rotations (rr)	Manure (man)
Reduced Tillage (rt)	Improved variety (iv)	Residue retention (r)	Inorganic fertilizer (if)
Zero Tillage (zt)	Trees (t)	Cover Crops (cc)	
		Mulch (mul)	

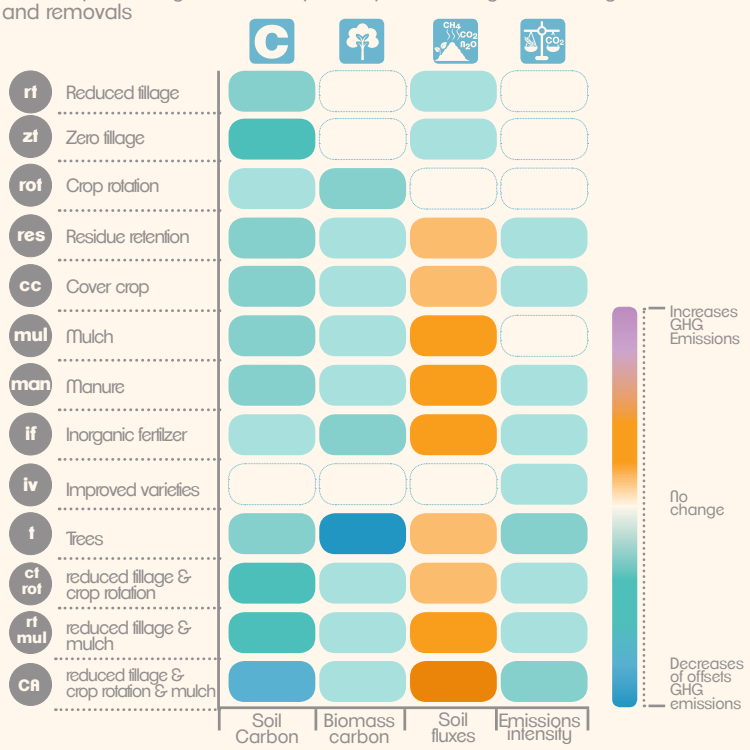
PRODUCTIVITY

Percent change in yield or income from the CSA practice relative to a baseline practice for all crops combined. Dashed lines represent the mean Percent change, and bar length shows the 95% confidence intervals around the mean.



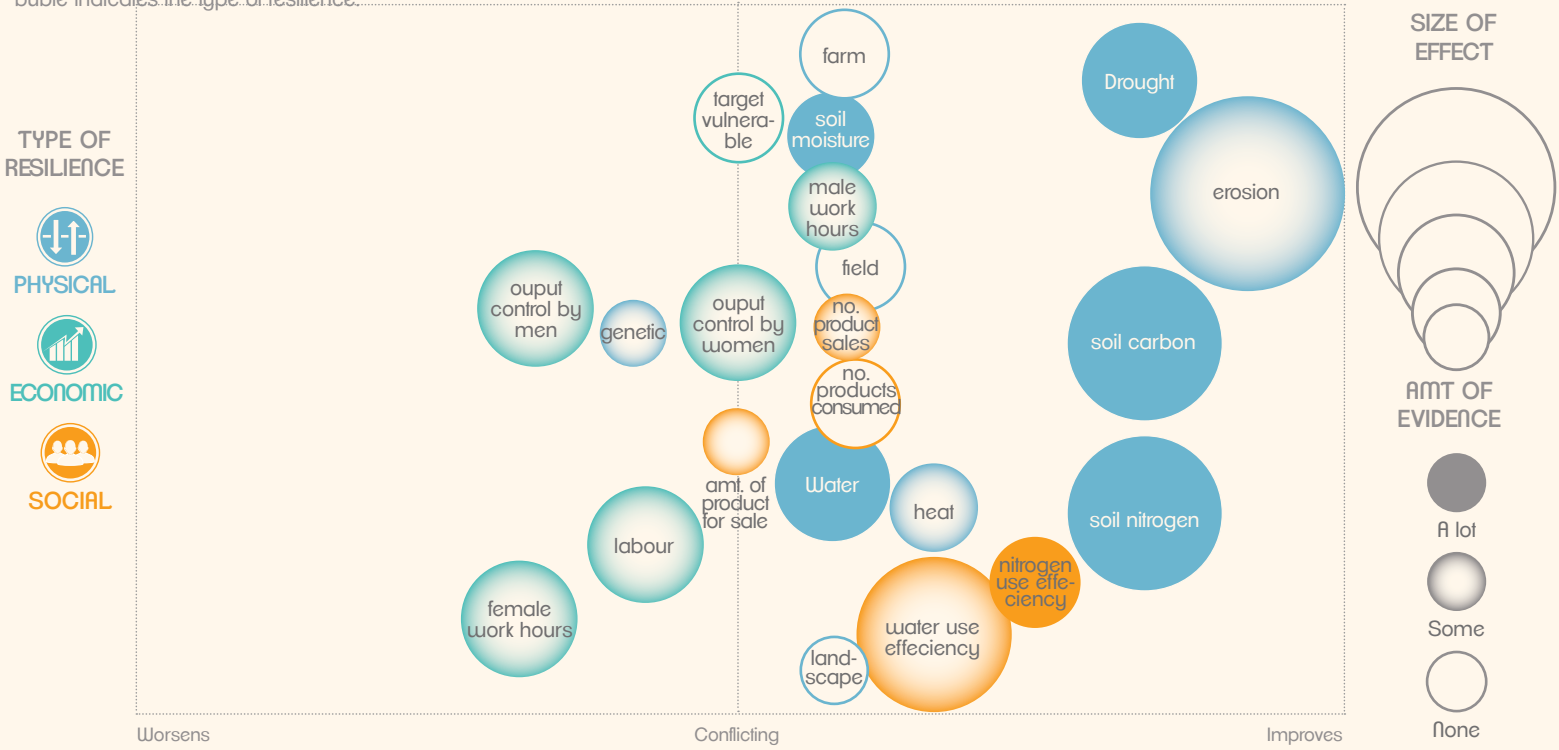
MITIGATION

Heat map showing effects of improved practice on greenhouse gas emissions and removals



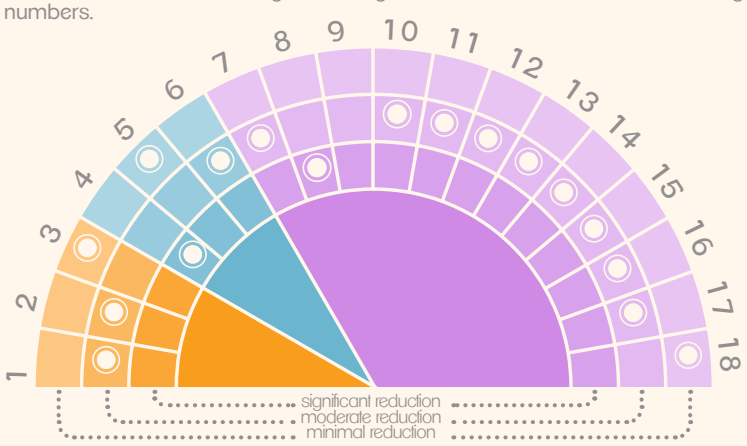
RESILIENCE

The magnitude (size of bubble), sign (position of bubble), and amount of evidence (fill of bubble) for impact of CSA practices on resilience indicators. Color of the buble indicates the type of resilience.



CLIMATE RISKS

The relative reduction in climate risk by using conservation agriculture. Dots closer to the center indicate greater mitigation of each climate risk, identified by numbers.



TEMPERATURE

1. High mean temperature
2. Days with a max temp > 35°C
3. Days with a max temp > 40°C

PRECIPITATION

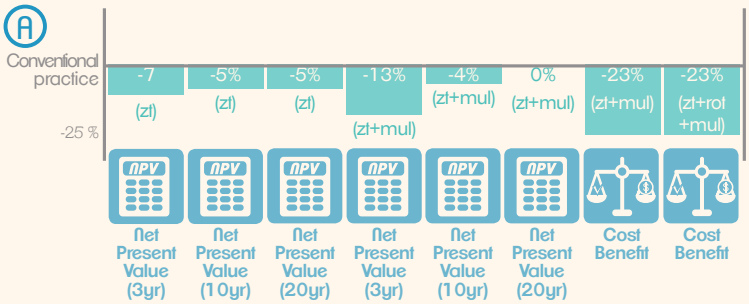
4. Lower mean rainfall
5. Higher mean rainfall
6. Large scale flood

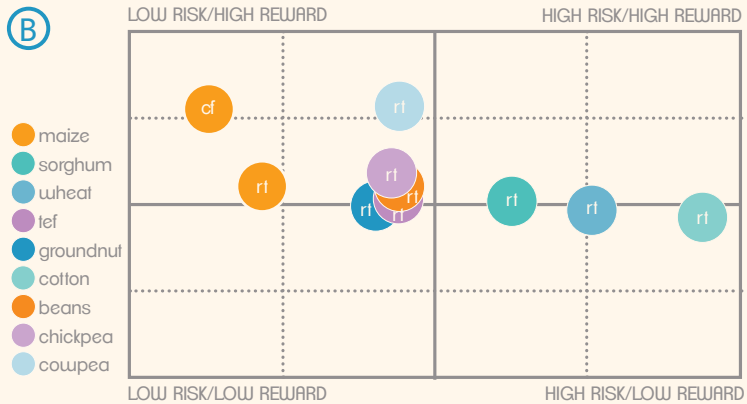
SEASONAL CHANGES

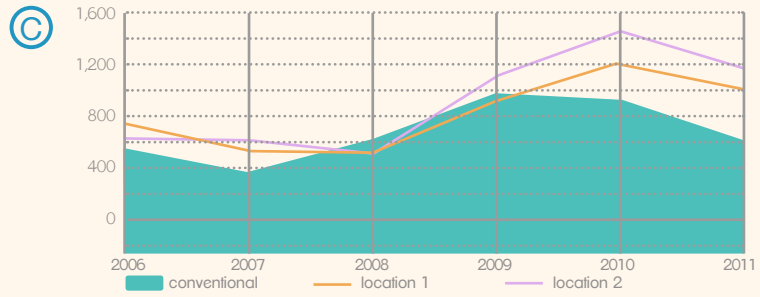
7. Flash floods
8. High 1-hour rainfall intensity
9. Heavy hail events
10. Rainfall distribution (variability) within season
11. 10-day dry spells
12. Seasonal droughts
13. Consecutive seasonal droughts
14. Later onset of rainfall season
15. Earlier end date of the rainfall season
16. Decreased predictability of the rainfall season
17. Increased uncertainty in rainfall distribution
18. Increases in cloudiness and humidity

BUSINESS CASE

(A)Change in economic performance relative to the conventional practice, (B) Semi-quantitative assessment of risk (change of decrease in yields) vs. reward (mean increase in yield) for various crops under CSA practices identified by code (C) Net returns (USD/ha) on investment over time.







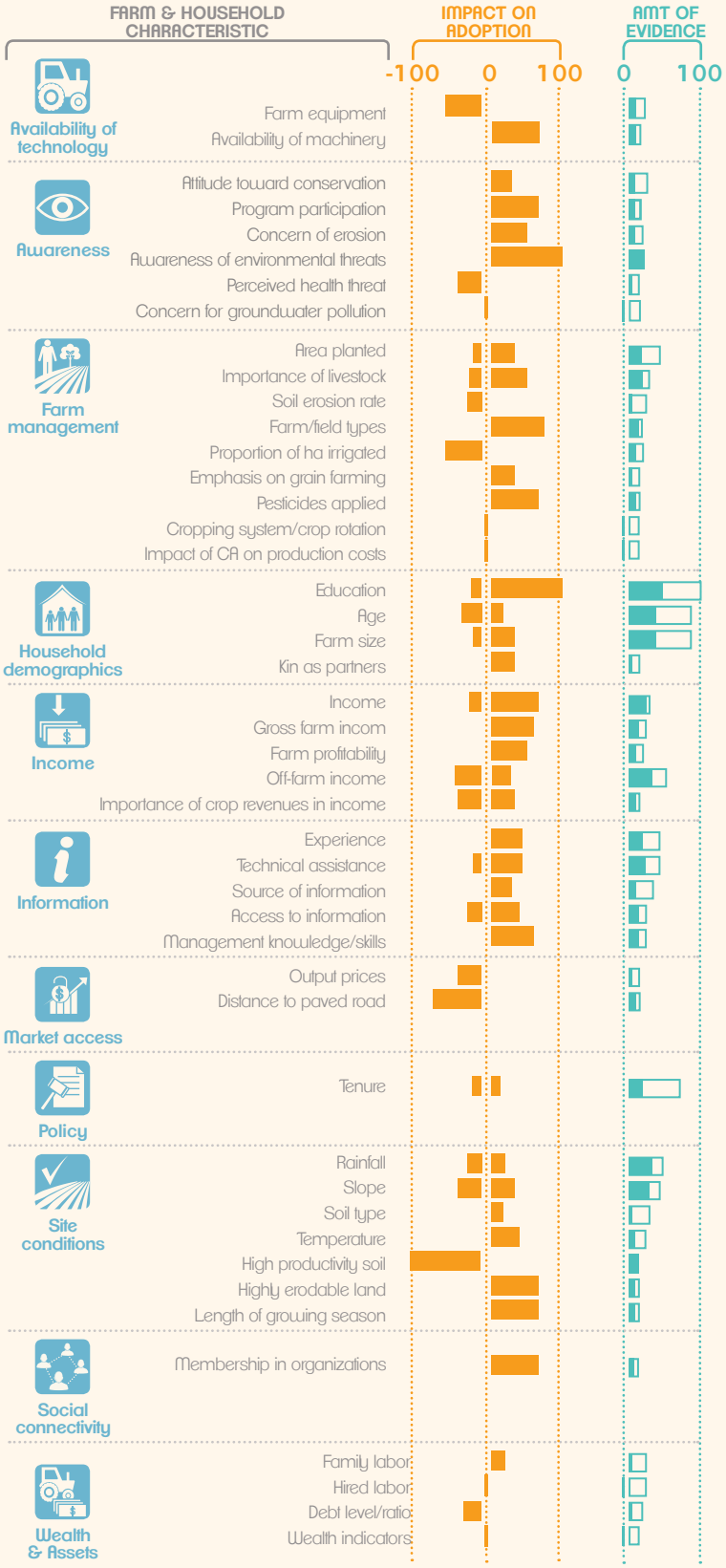
SCALING UP

CURRENT ADOPTION

Current rates of adoption of Conservation agriculture

BARRIERS TO ADOPTION

Impact on adoption shows the proportion of studies where farm and household characteristics have a positive (to the right) or negative (to the left) s impact on adoption, and significance shows the number of studies where that factor was significant (filled bar) or insignificant (open bar) on adoption.



MORE INFORMATION

The CSA X-ray is based on published data and expert opinion. Sources used for each indicator can be found on the 'CSA X-ray' repository on Harvard's Dataverse. We thank the CGIAR Research Program on Climate Change, Agriculture, and Food Security for funding the Partnerships for Scaling Climate-Smart Agriculture (P4S) Project that conceived of the X-rays and the United States Agency for International Development for their support of staff executing the vision.

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READING THE X-RAY

TECHNOLOGIES

Description of the CSA technologies covered. Each has an abbreviation that will be used throughout the X-RAY.

PRODUCTIVITY

Percent change (%) in productivity indicators under CSA technologies as compared to conventional practices. The vertical line at 0% represents no change in productivity. In each colored bar, the mean percent change is shown as a dashed line, and the width of the bar represents the 95% confidence interval around the mean for percent change in productivity. The position of the bar indicates the magnitude of change and the size the bar is indicative to the variability for the crop and practice.

MITIGATION

Change in greenhouse gas emissions and carbon stocks under CSA shown as a heat map. Warm colors (orange to purple) mean an increase in climate forcing or lower mitigation potential, while cool colors (green to blue) mean a decrease in climate forcing or higher mitigation potential. Where there is no expected change or no data, the square is empty. Data based on published literature and expert opinion are shown for soil carbon, aboveground biomass, soil GHG fluxes, and emissions intensity (emissions per unit product).

RESILIENCE

Impact of CSA practices on indicators of physical (blue), economic (green), and social (orange) resilience. The size of the bubble relates to the magnitude of change, for example a larger change in that indicator under CSA. The location of the bubble on the horizontal axis indicates the direction of the change. Bubbles to the right of the dotted line show improvement in resilience, while bubbles to the left decrease that proxy for resilience. Bubbles siting on the dotted line mean that there is conflicting evidence – sometimes that resilience indicator improves and sometimes it doesn't. The fill (shading) of the bubble indicates how much evidence is available. Open bubbles mean the change is theorized but no evidence is available, shaded bubbles mean some evidence is available, and filled bubbles mean a lot of evidence is available.

CLIMATE RISKS

Around the semi-circle, unique numbers identify eighteen climate risks potentially addressed by CSA. The semi-circle is divided into three levels (boxes) indicating the degree to which the practice may mitigate climate risks (minimal, moderate, or significant) and colors representing various categories of climate risks (temperature, precipitation, and seasonal changes). For each climate risk, a circular mark is placed in the respective position (box) indicating how well that intervention addresses that climate risk.

BUSINESS CASE

(A) Percent change in economic performance relative to the conventional practice for various indicators. Increases in economic performance are positive bars, whereas decreases in economic performance are negative bars.
(B) Risk vs. Reward for CSA practice/crop combinations. Reward relates to the change in yield is on the vertical axis, and risk relating to the chance of decrease in yields is on the horizontal.
(C) Illustrative economic performance of CSA practices relative to a control over time.

SCALING UP

For current adoption, each person icon represents a number of small farmers who have adopted that particular practice in that location. In Barriers to Adoption, each farm and household characteristic (listed in grey) has an associated impact on adoption (left orange panel) and significance (right blue-green panel). Impact on adoption panel shows the proportion of studies where that factor positively (to the right) and negatively (to the left) affected adoption. Interesting to note bars that cross the vertical center line (positive and negative effects depending on context) and the size of the bar indicating how many studies have included that factor. The significance panel shows the number of studies conducted on that factor (open bar) and the number where that factor significantly impacted adoption (filled bar).