



X-RAY

Bare bones evaluation of climate-smart agriculture practices & technologies



CLIMATE SMART AGRICULTURE IN TANZANIA 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 practices¹.

Key messages for the CSA X-ray for Tanzania are:

<i>Productivity</i>	Most CSA practices increase crop yields in Tanzania, when compared to conventional practices, with the exception of deficit irrigation for maize. Yield gains are typically substantial, from 30-125% increase in mean yield, with gains in rice yields under system of rice intensification (SRI) showing the largest gains. Impacts of changing to CSA practices on farmer income are variable dependent on crop and practice, but generally positive.
<i>Resilience/ Adaptive Capacity</i>	Many CSA practices improve physical resilience of farms by improving soil health and reducing erosion, creating more sustainable productivity. However, some practices such as reduced tillage and mulching may increase labour demands, particularly for women.
<i>Mitigation</i>	CSA practices in Tanzania increase organic carbon in the soil and thus offset GHG emissions. However, increases in soil carbon may also increase soil respiration, contributing to climate change.
<i>Climate Risks</i>	Because of the positive affects on soil physical properties, many climate-smart practices have potential to mitigate many of the precipitation and seasonal affects of climate change. In particular, water harvesting techniques can ameliorate threats from heavy rain, drought tolerant varieties can help with warmer temperatures and intra-seasonal droughts, and residue retention, reduced tillage, and deficit irrigation can address lower and unpredictable rainfall.
<i>The Business Case</i>	Most CSA practices increase economic returns to land and labour relative to conventional practices. However, there are also risks of decreases in yield or income with each practice that need to be considered with the potential reward.
<i>Scaling up</i>	Adoption rates for CSA practices vary widely in Tanzania, with some practices already in high use such as intercropping, while other potentially beneficial practices such as green manure, agroforestry and improved varieties lagging behind.
<i>Barriers to adoption</i>	The factors affecting adoption of CSA are inconsistent across studies in Tanzania. Many of factors have both positive and negative impacts depending on the study and few are universally influential in the same direction. However, wealth, land tenure, and access to extension agents consistently increase adoption rates.

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 X-RAY

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CSA IN TANZANIA



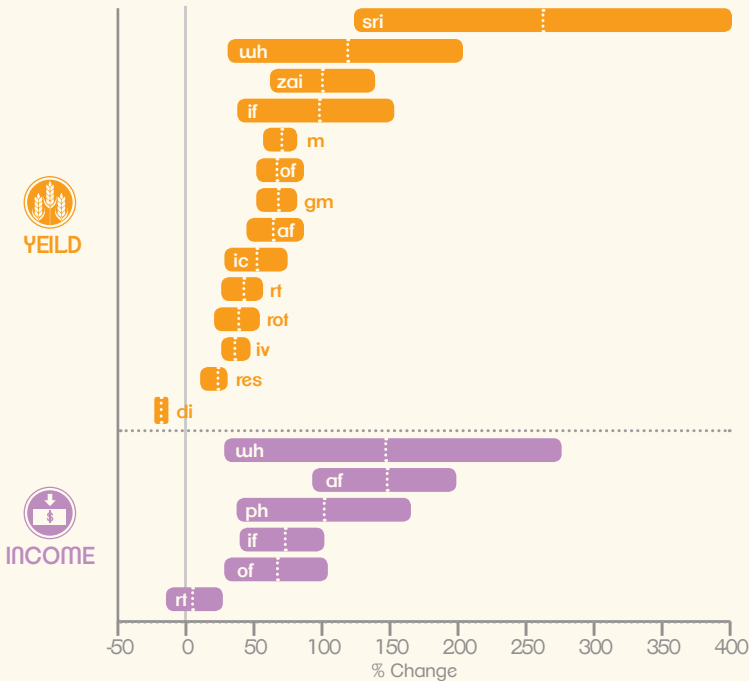
FARM LEVEL MANAGEMENT PRACTICES FOR CROPS TO IMPROVE PRODUCTIVITY, RESILIENCE TO CLIMATE CHANGE, AND PROVIDE MITIGATION CO-BENEFITS IN TANZANIA

CSA TECHNOLOGY

SYSTEMS	NUTRIENT MANAGEMENT	CROP MANAGEMENT	SOIL MANAGEMENT	WATER MANAGEMENT
Agroforestry (af)	Inorganic Fertilizer (if)	Improved varieties (iv)	Green Manure (gm)	Drip Irrigation (di)
System of Rice Intensification (sri)	Organic Fertilizer (of)	Intercropping (ic)	Mulching (m)	Zai pits (zai)
		Crop Rotation (rot)	Reduced Tillage (rt)	Rainwater Harvesting (uh)
		Postharvest Storage (ph)		

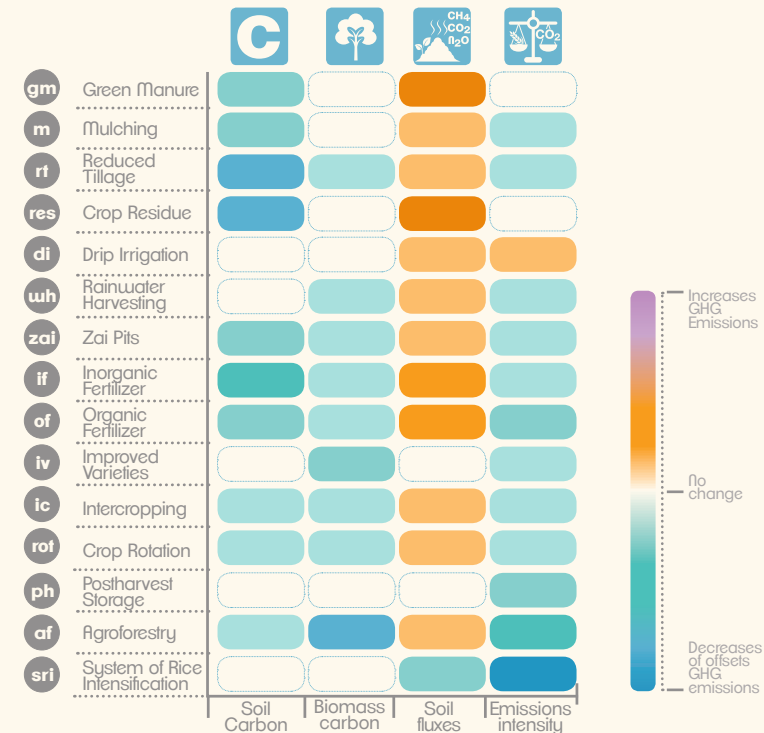
PRODUCTIVITY

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.



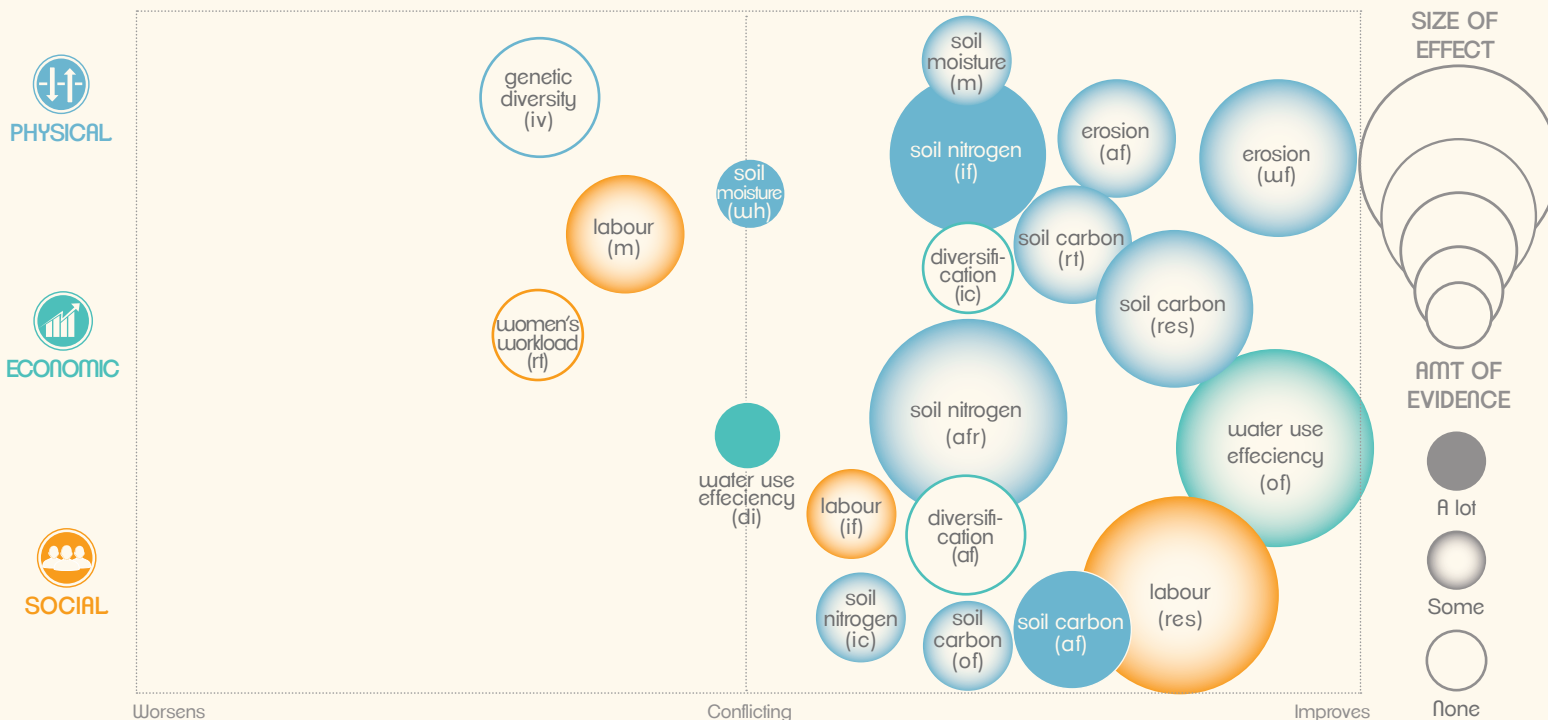
MITIGATION

Heat map showing effects of CSA practice on greenhouse gas emissions, carbon stocks, and emissions intensity.



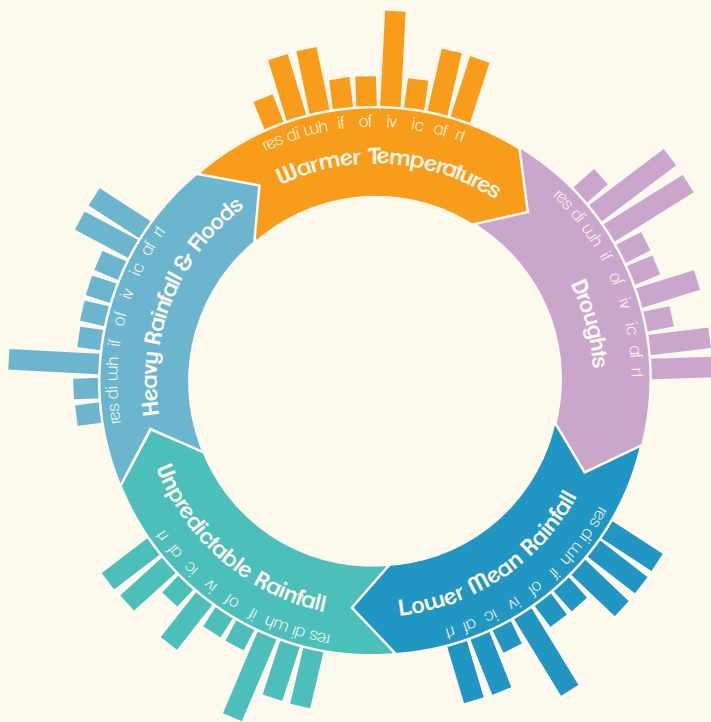
RESILIENCE

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 bubble indicates the type of resilience.



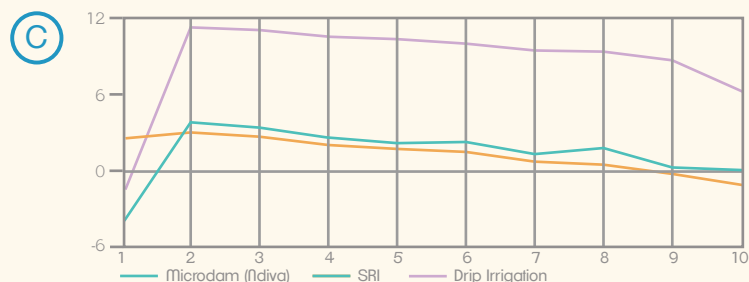
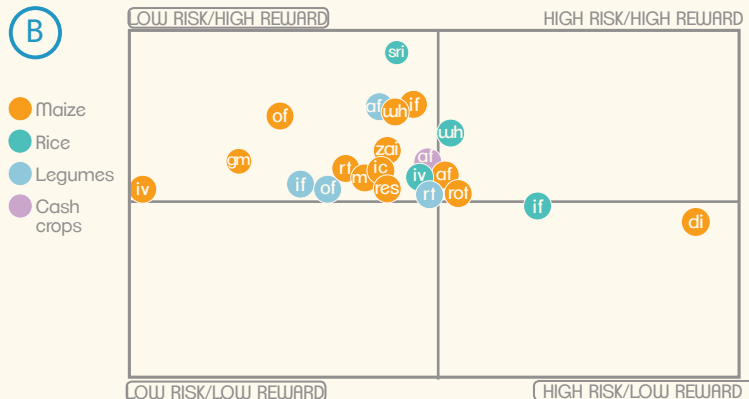
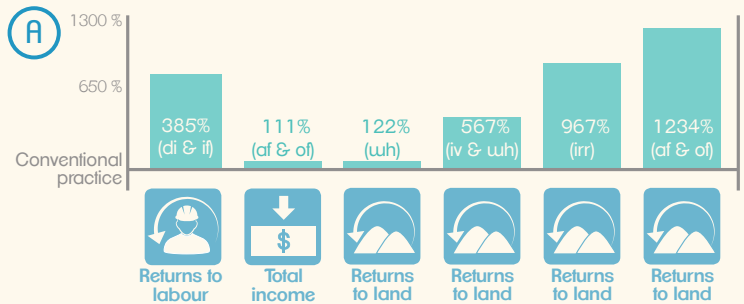
CLIMATE RISKS

The relative reduction in climate risk by using CSA practices. Larger bars indicate greater mitigation of the climate risk identified by color. Practice codes are the same as in CSA TECHNOLOGIES.



BUSINESS CASE

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



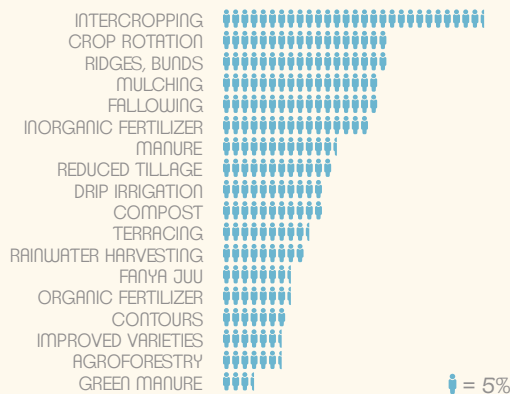
MORE INFORMATION

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.

SCALING UP

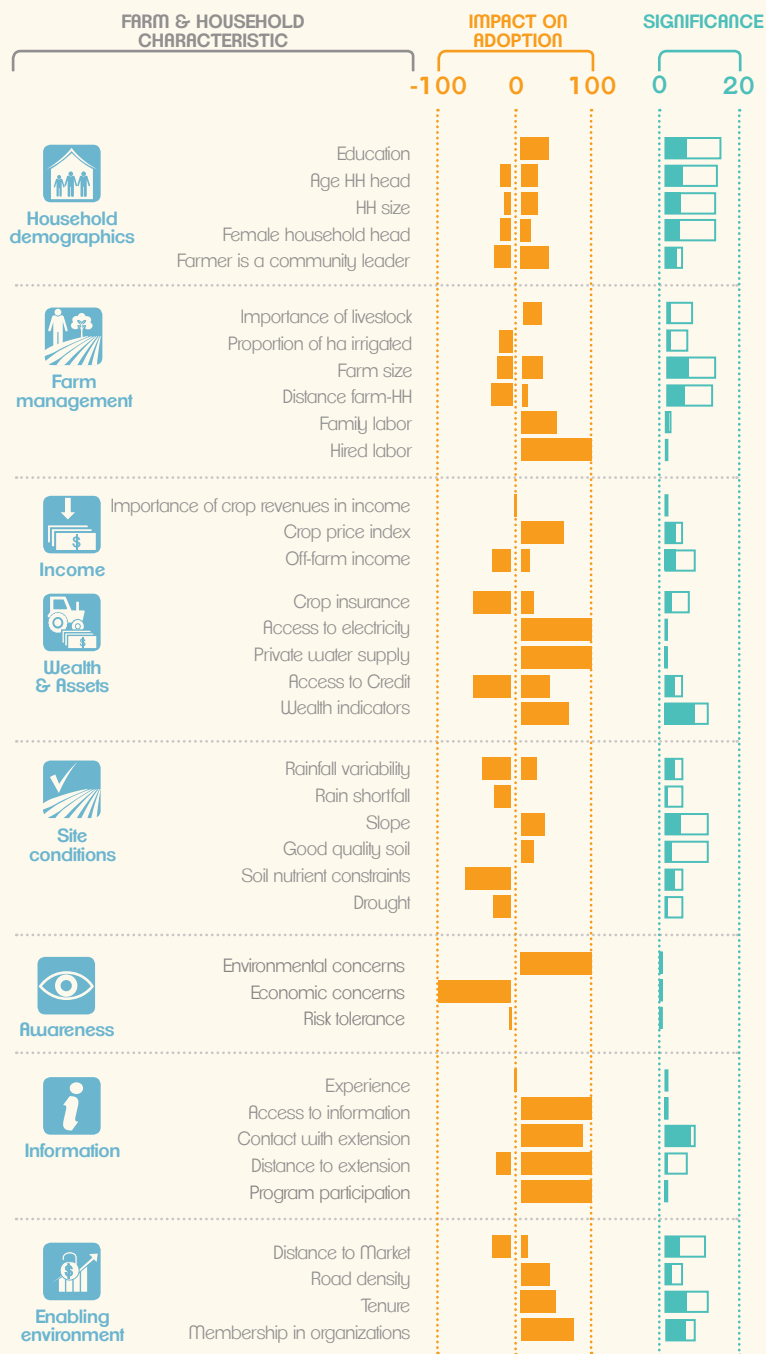
CURRENT ADOPTION

Current mean rates of adoption of CSA practices in Tanzania.



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) impact on adoption. Significance shows the number of studies where that factor had a significant (filled bar) or insignificant (open bar) impact on adoption.



CONTACT

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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 sitting 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 circle are five key climate risks potentially addressed by CSA. For each CSA practice and climate risk combination, the height of the bar indicates how well that practices addresses that climate risk. Higher bars mean better mitigation of 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).