

ECONOMIC IMPACT ASSESSMENT ON SANREM

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SANREM CRSP
Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program



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Objectives of Economic Impact Assessment Program on SANREM

To identify:

- 1) Costs and benefits of CA practices
- 2) Optimal CA practices in target cropping systems, and optimal sequencing of CAPS elements
- 3) Broader economic and social impacts of CA adoption
- 4) Policy changes to encourage CAPS adoption



Structure of Impact Assessment

- The Impact Assessment cross-cutting research program has interacted with regional programs, as economic analyses take place in both the impact assessment program and the regional programs



Collaboration with regional programs

- Regional programs have conducted baseline surveys and many have summarized and compared available input cost and yield data
- Regional programs (Lesotho, Mozambique, Ecuador, Uganda, Ghana) have conducted analyses of factors affecting adoption of CA practices
- Regional programs in Ecuador and Nepal have assessed optimal CAPs
- Regional programs (Uganda and Ecuador) have assessed value farmers place on traits such as erosion control



Analysis in Ghana of 3 years of cost of production data (by Tim Dalton and student at Kansas State)

Example (2009): (a) Nyoli with conventional versus no-till

Costs (GH¢/ha)	Maize		Soybeans	
	CT+NPK	NT+NPK	CT	NT
Labour	88.00	88.00	163.80	163.80
Purchased input	463.00	352.00	150.00	39.00
Total variable cost	551.00	440.00	313.80	202.80
Yield (ton/ha)	0.27	0.20	1.11	1.00
Revenue(GH¢/ha)	140.19	103.38	579.18	521.14
Gross margin(GH¢/ha)	-410.81	-336.62	265.38	318.34
B/C ratio	0.75	0.77	0.85	1.57
Returns to labour	1.59	1.18	3.54	3.18
labour productivity(Kg/Mndys)	4.49	3.31	18.56	16.70

(b) Busa-Tangzu with conventional versus no-till

Costs(GH¢/ha)	Treatments			
	CT+NPK	NT-NPK	NT+NPK	NT+P
Labour	184.40	182.40	182.40	182.40
Tractor use	150.00	0.00	0.00	0.00
Fertilizer	125.00	0.00	125.00	170.20
Herbicide	0.00	39.00	39.00	39.00
Total variable cost	459.40	221.40	346.40	391.60
Yield (ton/ha)	0.95	0.61	0.85	0.81
Revenue(GH¢/ha)	683.71	442.22	612.14	585.50
Gross margin(GH¢/ha)	224.31	220.82	265.74	193.90
B/C ratio	0.49	0.99	0.77	0.49
Returns to labour	3.71	2.42	3.36	3.21
labour productivity(Kg/Mndys)	15.83	10.24	14.17	13.55

Ghana – Partial budgets for trials

(C) Nandom maize trials with flat, tied ridges, and tied ridges plus grass strips treatments

<i>Costs(GH¢/ha)</i>	<i>TREATMENTS</i>		
	<i>FLAT</i>	<i>TIED RIDGES</i>	<i>TR + GRASS STRIPS</i>
<i>Labour</i>	182.00	186.00	188.00
<i>Fertilizer</i>	385.00	385.00	385.00
<i>TVC</i>	567.00	571.00	573.00
<i>Yield (ton/ha)</i>	2.8	2.3	3.1
<i>Revenue(GH¢/ha)</i>	1326.60	1099.80	1474.20
<i>Gross margin(GH¢/ha)</i>	759.60	528.80	901.20
<i>B/C ratio</i>	1.34	0.93	1.57
<i>Returns to labour</i>	7.29	5.91	7.84
<i>labour productivity(Kg/Mndys)</i>	46.10	38.20	51.20

See several more budgets (for 2010 and 2011) and results from baseline survey in T. Dalton, I. Yahaya, and J. Naab “Perceptions And Performance of Conservation Agriculture Practices in Northwestern Ghana,” *Agriculture, Ecosystems, and Environment*, 187 (April 2014): 65-71.

Net benefits positive (except for maize in Nyoli) but varied substantially over the years

Nepal: Enterprise budgets (from Paudel, Halbrendt, and other at Hawaii)

Cost of production (CoP), labor requirement and revenue

Systems	$COP_{BLC} (\$/h)$ a	Labor (person. days/ha)	Labor cost (\$/hr)	Revenue (\$)	$Profit_{BLC}$ (\$)	$Profit_{ALC}$ labor \$
FT Maize-->Millet	203	516	1146	1314	1111	-35
FT Maize-->BG	209	514	1143	2248	2039	897
FT Maize-->Cp	203	461	1025	2190	1987	962
FT Maize-->Mi+BG	210	633	1406	1821	1611	206
FT Maize-->Mi+Cp	207	686	1524	2040	1833	309
ST Maize-->Mi+BG	210	608	1351	1822	1612	261
ST Maize-->Mi+Cp	207	633	1408	1934	1727	319

**NOTE: BLC = before labor cost, ALC = after labor cost, FT = full tillage, ST = Strip tillage;
Mi+BG = millet and blackgram intercrop; Mi+Cp = millet and cowpea intercrop
--> sign indicate preceding crop was followed by the succeeding crop in second season**

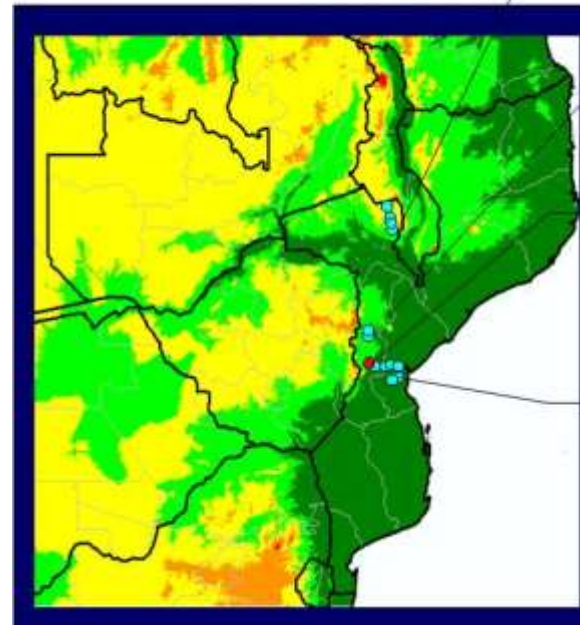
Mozambique Budgets (from Dayton Lambert at Tennessee)

Job planter

Tete, Manica, and Sofala Provinces, Mozambique 2008 – 2011

- Check, Basins, Jab planter
- Maize/cowpea rotations
- N = 638 farmers, 22 villages
- NPK/Urea (all plots)
- Herbicide on CA plots

Basins (“likoti”)



4 Sites in Angonia and Tsangano (Tete province)

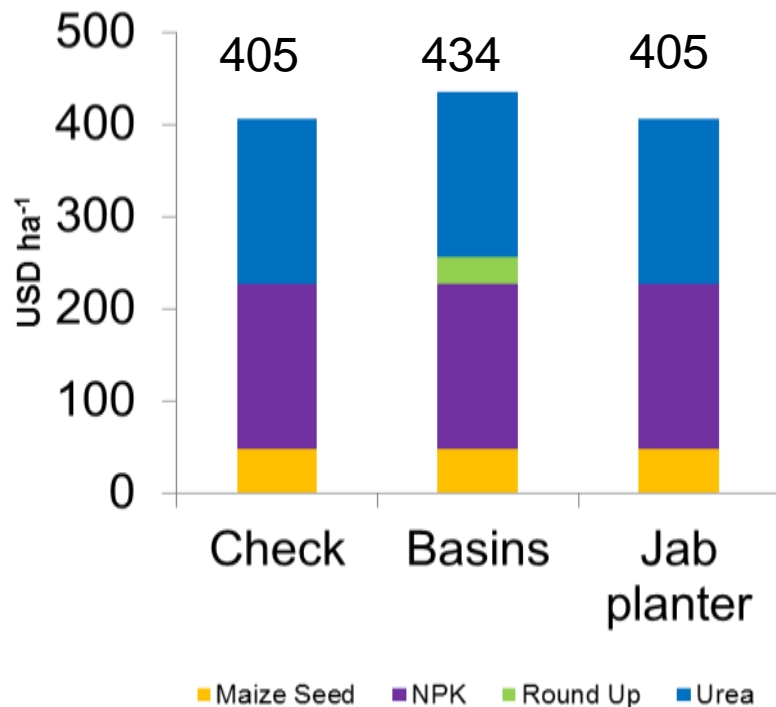
2 Sites in Barwe (Manica province)

2 Sites in Sussundenga and Gondola (Manica province), Sussundenga Research Station

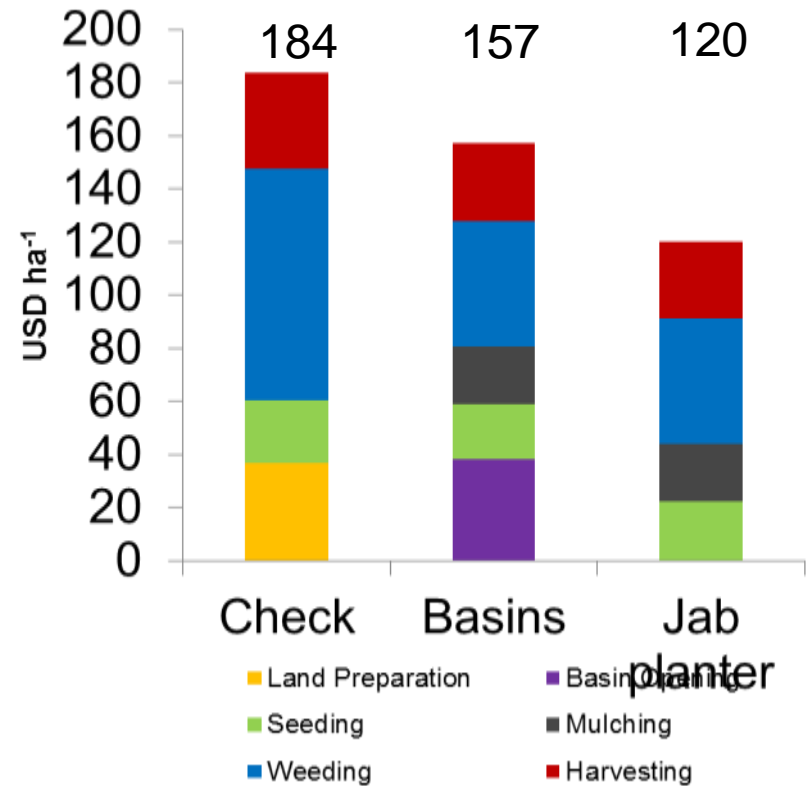
4 Sites in Buzi and Nhamatanda (Sofala province)

Average input and labor costs for maize: Mozambique (2008 – 2011)

Input costs



Labor costs



Net returns: conventional tillage treatments and CA planting technologies for maize, Mozambique, 2008 – 2011 (N = 631 farms)

Net returns (USD ha ⁻¹)	Control	Basin	Jab planter
Mean	104	148	195
Std. Dev.	452	478	499
CV	435	323	257
----H ₀ : distributions not different*----			
Control		0.07 (0.0776)	0.12 (0.0002)

*Kolmogorov-Smirnoff test; D-statistic (p-value)

Field production survey: Butha Buthe, Lesotho

- Survey data
- Compared management of *No till* and *Conventional fields*
- 728 field-level observations
- Maize production (summer, 2010)
- 553 conventional/51 no-till (usable)
- Fertilizer (NPK), labor, maize production, labor/input costs, plot size, seeding rate, maize prices

Field level inputs and production (Lesotho, 2010)

Variable	Mean	N	Mean	N
	-----CA-----		-----Conventional---	
Field area (ha)	0.48	51	0.76	553
Seed (kg)	4.25	44	7.90	478
Fertilizer (kg)	7.02	44	26.55	478
Hired labor (person days)	2.70	51	10.19	553
Maize production (kg)	145.23	51	256.33	553

*Bold entries are different at the 5% level (t test)

Example: Linear programming analysis (Ecuador) (from A. Nguema at Virginia Tech)

Developed production coefficients and constraints based on:

- Initial survey of 286 farms
- Expert interviews with agronomists, economists, and soil scientists
- Follow-up farmer survey with 45 participants from the upper watershed and 43 from the lower watershed



Results: Upper Watershed

- Optimal solution for typical farm household
 - 1180 square meters of:
(potatoes, fallow land, fava beans, fallow land rotation; conventional tillage; no deviation ditches; no cover crop)
 - 1078 square meters of:
(potatoes, oats-vetch, barley, fava beans rotation; conventional tillage; no deviation ditches; removal of cover crop)
 - 864 square meters of:
(potatoes, oats-vetch, barley, oats-vetch rotation; conventional tillage; no deviation ditches; incorporation of cover crop)

Total of 3122 Square meters of crops per farm household

Results: Upper Watershed

- Net revenue per farm: \$2280
- Deviation ditches not profitable
- Conventional tillage more profitable than reduced tillage



Results: Lower Watershed

- Optimal solution per farm household: 8,286 meters of corn, oats-vetch, beans, oats-vetch rotation; reduced tillage; manual weeding; removal of cover crop
- Net revenue per farm: \$7700
- Reduced tillage more profitable than conventional tillage
- Incorporation of cover crop not profitable



Aggregate Benefits of CAPS through Economic Surplus Analysis

- Countries: Lesotho, Ecuador and Nepal
- Crops: maize, beans, potatoes, millet, and cowpeas
- Data required:
 - Input cost and yield data from the regional projects
 - Supply and demand elasticity estimates
 - Price and quantity data
 - Adoption rates (projecting benefits for 1%, 3%, 5% adoption)
 - Research costs

Examples of aggregate impact results







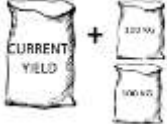


- With 1% adoption over 12 years (discounted at 5%)
 - Ecuador: Net present value (NPV) of at least \$15 to \$18 million in maize, none in potato, and minimal in beans
 - Nepal: \$13 million for maize/cowpeas/millet
 - Lesotho Lekoti system with maize: \$12 million



Information for policy analysis

- Knowing how much farmers would be willing to pay for attributes of conservation agriculture, gives an indication of how likely farmers will be to adopt conservation agriculture with or without a payment-for-environmental-services and what the payment might have to be.
- Kate Vaiknoras completed a **choice experiment** survey and analysis to assess the value that farmers in Tororo and Kapchorwa districts in Uganda place on the attributes of Conservation Agriculture

Example of survey question

EXAMPLE QUESTION				
	YIELD	EROSION	LAND PREPARATION LABOR	INPUT COSTS
OPTION A <input type="radio"/>				<input type="text" value="CURRENT COSTS"/>
OPTION B <input type="radio"/>				<input type="text" value="CURRENT COSTS"/> + <input type="text" value="30,000"/> <input type="text" value="30,000"/>
OPTION C <input type="radio"/>				<input type="text" value="CURRENT COSTS"/>

Sample size and model

- 400 farmers surveyed (200 in each district) after pilot testing
- 10 enumerators used in each district who were trained on the survey and conducted interviews in local languages
- Kate used a mixed logit model to arrive at value placed on traits associated with cover crops, minimum tillage, and cover crops



Results

- For most of the models estimated, farmers had a positive and significant willingness to pay for increases in yield as well as reductions in erosion.
 - Labor savings were less of an incentive for farmers to adopt CA.
 - **See Kate's poster for details.**



Other studies

- **Choice experiment in Ecuador** on value placed by farmers on conservation agriculture traits (Michael Barrowclough with assistance from undergraduate interns who conducted survey of 230 farmers in June 2013).
- **Risk analysis** conducted in Uganda to assess willingness of maize farmers to accept potential risk associated with new CA farming practices.
 - Based on survey and analysis with 400 farmers in Tororo and Kapchorwa, poorest farmers were just as willing to accept risk as better off farmers (**See poster by Barry Weiler-Landis for details**).



Poverty effects of CAPS

- Analysis of poverty estimates for the Eastern Ugandan district of Tororo and assessing the size of average treatment (yield and income) effect that would need to be obtained from CAPS to have a measurable impact on poverty in the district.
 - Uses both World Bank Ugandan national survey data and local survey data from Tororo
 - Compare this impact with preliminary estimates of average treatment effects of CAPS (Jarrad Farris study currently underway)



Conclusions

- Positive benefits from Conservation Agriculture in each region studied. Earlier economic surplus analyses, not reported on here, found that results vary widely among treatments and crops:
 - Some non-profitable economic outcomes, but others indicated 10's to 100's of millions of potential economic benefits over 12 years even with relatively low levels of adoption in some settings
- Farmers willing to pay not just for traits such as yield but for erosion benefits as well



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A photograph of a cornfield with green leaves and golden tassels. The text "Thank You" is overlaid in yellow.

Thank You