



Economic Impact of Research Investment in the Development and Dissemination of Improved Cowpea Varietal Technology in Senegal

B. Magen¹, E. Crawford², M. Maredia³

1. Recent MS Graduate, Department of Agricultural, Food and Resource Economics magenben@gmail.com
 2. Professor, Department of Agricultural, Food and Resource Economics crawfor5@msu.edu
 3. Associate Professor, Department of Agricultural, Food and Resource Economics maredia@msu.edu

MICHIGAN STATE UNIVERSITY



Introduction

Since the early 1980s, the *Senegalese Institute of Agricultural Research* (ISRA) has worked with the *Dry Grain Pulses Collaborative Research Support Program* (CRSP) (now known as the Legume Innovation Lab) on the development and release of three cowpea varieties. These are short-cycle, semi-erect varieties: **Mouride**, released in 1991; **Melakh**, released in 1995; and **Yacine**, released in 2005.

Cowpeas are a high protein pulse crop harvested for both dry beans and green pods. As green pods they serve as a crucial source of nutrition before the main harvest. This paper summarizes the results of an adoption survey conducted in 2010 to assess the impact of cowpea research and seed system development efforts in three main cowpea growing regions in Senegal: **Thiès**, **Diourbel**, and **Louga**. These are the three largest cowpea growing regions in Senegal. In 2010, 40.0% of Senegalese cowpea production was in Louga, 22.2% in Thiès, and 9.0% in Diourbel. Results from a 2010 household level survey and past impact studies are used to derive the estimates of cowpea varietal adoption over time and the gains in yield from the adoption of improved varieties (IVs).



Methods

- Adoption rates were estimated for each variety using a logistical adoption curve derived from survey estimates of adoption in the 2004 rainy season (Boys 2007) and the 2010 rainy season (Magen 2012). Adoption rates were projected through the year 2020.
- Yields for all CRSP varieties and Traditional Varieties (TVs) were determined using survey data from the 2010 season.
- Research costs for CRSP's investments and ISRA expenditures on varietal research were derived from data provided by the CRSP management office and the author of the previous impact study in Senegal.
- An economic surplus modeling approach is used to estimate aggregate benefits from the adoption of CRSP varieties. Costs and Benefits were projected through the year 2020.
- Benefits from the adoption of CRSP varieties were compared with program costs using the *ex post* economic impact assessment approach. This method was used to derive rates-of-return estimates on these investments.

Adoption

- Adoption of CRSP varieties in the three study regions was estimated to be **42%** of area planted to cowpea. The breakdown by Region was as follows:
 - Louga: **58.7%**
 - Diourbel: **33.1%**
 - Louga: **5.6%**
- Adoption of all IVs was estimated to be 48% of area planted to cowpea.
- **27.2%** of the cowpea area in Thiès was identified by respondents as planted to a non-CRSP improved variety.
- The high adoption of improved CRSP varieties primarily reflects the focused efforts by multiple entities in the past five years on the multiplication and dissemination of breeder seeds and certified seeds of Melakh and Yacine.

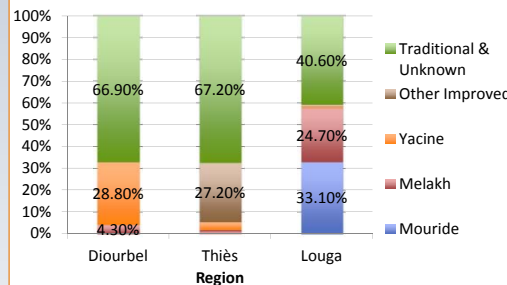
Economic Results

- The **Internal Rate of Return** is **17.9%** when benefits are projected through 2020.
- The **Net Present Value** is **78.6m US\$** using a discount rate of 4.25%.
- The majority of program benefits come from the Louga region, due to the confluence of high adoption rates, significant yield improvements, and the large area cultivated to cowpea.

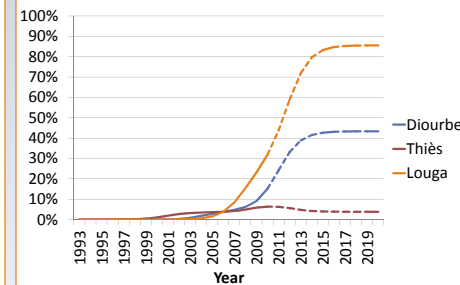
Estimated costs, benefits and net benefits, in thousand US\$

Year	Costs	Benefits	Net Benefits	Year	Costs	Benefits	Net Benefits
1982	284	0	-284	2001	103	266	163
1983	436	0	-436	2002	113	438	324
1984	339	0	-339	2003	90	861	772
1985	475	0	-475	2004	109	1,081	971
1986	284	0	-284	2005	156	3,215	3,059
1987	286	0	-286	2006	47	3,560	3,513
1988	265	0	-265	2007	50	7,292	7,242
1989	243	0	-243	2008	101	12,473	12,371
1990	231	0	-231	2009	84	11,863	11,779
1991	224	0	-224	2010	103	11,211	11,108
1992	263	0	-263	2011	120	23,165	23,045
1993	237	0	-237	2012	122	25,074	24,953
1994	134	0	-134	2013	132	26,045	25,913
1995	151	0	-151	2014	138	26,420	26,282
1996	103	-1	-104	2015	141	26,560	26,419
1997	151	63	-89	2016	142	26,612	26,470
1998	165	91	-73	2017	142	26,631	26,489
1999	104	114	9	2018	142	26,638	26,496
2000	118	80	-39	^ Years in gray are projected estimates			

Weighted percentage of total cowpea area grown by variety and region



Adoption curves of CRSP varieties (as a percentage of all cowpea area) by Region



Research Questions

- This study uses results from a survey of cowpea farmers in the 2010 rainy season in order to answer the following questions:
- 1) How much of the total land devoted to cowpeas can be attributed to improved varieties?
 - 2) How much of the total cowpea grain production is attributed to improved varieties?
 - 3) What is the yield gain from growing IVs of cowpea?

An adoption curve was projected for each variety based on the 2010 survey data and past impact studies (Boys et al. 2007). The adoption estimates were combined with yield data and available research spending figures to determine:

- 1) What is the economy-wide welfare gain from the adoption of improved cowpea varieties?
- 2) What is the rate of return to research investments by the CRSP and ISRA on cowpea development and dissemination?

Yields of Improved Varieties and Traditional Varieties

- Reported yields of CRSP varieties were consistently higher than TVs across all the regions.
- The yields of the three CRSP varieties varied significantly among regions.
- There was little difference between green pod yields for IVs and TVs.

Dry Grain Yields By Variety (kg/ha)

	Melakh	Mouride	Yacine	Traditional (a)	All varieties
Diourbel	218	-	206.2	146.6	200.0
Thiès	460.7**	-	144.0	123.1	137.2
Louga	393.9**	687.8**	400.3	267.8	395.8
All 3 Regions	400	687.8	215.1	165.6	240.5

Source: Median yields from cowpea farmer survey in 2010 season

a. Defined in the survey as 'other' 'traditional varieties'

** Difference in yields between an IV and TV is significant at the 1% level

Sources

For details, see: Magen, B., M. Maredia and E. Crawford. 2013. "Economic impact of CRSP's investment in the development and dissemination of improved cowpea varietal technology: New evidence from Senegal" *Impact Assessment Research Brief No. 4*. Michigan State University.

Citations:
 Boys, K., M. Faye, J. Fulton, and J. Lowenberg-DeBoer. 2007. "The economic impact of cowpea research in Senegal: an ex post analysis with disadoption." *Agricultural Economics* no. 36 (3): 363-375.
 Magen, B. 2012. "An ex post economic impact assessment of Bean/Cowpea CRSP investment on varietal development in Senegal." *a Plan B Paper*. Michigan State University.
 Map from: <http://www.mapsofopenstreetmap.org>

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Sensitivity Analysis

- Sensitivity analysis was performed in order to measure the effect of several factors on the rates of return.
- The factors with the most significant effect were estimations of **research costs** and **supply elasticity**.
- Other factors with less influence when adjusted included **cowpea price**, **intercrop rates**, **adoption rates** and **yields adjusted +/- 25%**.
- Under every scenario with projected benefits, **IRR** was above 8%.

Conclusions

- Investments in cowpea varietal development research in Senegal have generated high economic returns of nearly 18% and contributed millions of dollars in production gains to the Senegalese economy.
- The benefits from growing IVs are two-fold: (1) yield increases reduce per-unit production costs and thus provide economic gains; (2) increased supply of green pods to consume in the hunger season contributes to household food security.
- Further research is needed into how the seed system and variety traits influence adoption and yields in different regions in Senegal.
- The large area in Thiès devoted to other IVs is puzzling, since non-CRSP varieties have not been promoted in that region. This points to the difficulty in identifying varieties when using the simple farmer elicitation method to estimate adoption rates.
- This study has only examined the aggregate, economy-wide impact of production gains in cowpea grain. Further examination of the effects of IVs (especially of green pod production) on household income and food security is warranted.