Allocative & technical efficiency of female-owned prepared millet SME's in urban Senegal

Hanna Carlson, Michigan State University, carls505@msu.edu

Selected Poster prepared for presentation at the 2023 Agricultural & Applied Economics Association Annual Meeting, Washington DC: July 23- 25, 2023

Allocative & technical efficiency of female-owned prepared millet SME's in urban Senegal

Hanna Carlson[a], Véronique Thériault[a], Thomas Reardon[a], Ndèye Fatou Faye Mané[b], Xavier Beogo[b]
[a]Agricultural, Food, and Resource Economics (AFRE), Michigan State University, East Lansing MI, 48824 [b]Senegalese Institute of Agricultural Research– Bureau of Macroeconomic Analysis (ISRA-BAME)

MOTIVATION

- Food processing is an important source of employment for women in Sub-Saharan Africa.
  - This research focuses on second stage processed products: highly processed foods made of multiple ingredients such as
- It's crucial to understand the choices women-operated small and medium sized enterprises (SMEs) are making, and how their choices affect their performance.
- We compare efficiency of those belonging to a group (processors organizations or cooperatives) to those who do not belong to any groups to see if membership status has an impact on efficiency through improved access to equipment, sales channels, and/or trainings.

QUESTIONS

- Is there a significant difference in efficiency between group and non-group women-operated SMEs?
- We contribute to the larger literature on the development of food markets and cereal value chains

DATA

- 922 second-stage processing SMEs, 827 of them process millet
- Sample across the 14 region capitals and 5 other major urban centers in Senegal stratified by city and type of actor (retailer or wholesaler)
- Data collected in March & April 2018

DESCRIPTIVE STATISTICS

Table 1: Demographics

Variable	Millet Processors (Group)	Millet Processors (Non-Group)	Millet Processors (Total)
n	148	679	827
Dakar	35%	33%	33%
Center (Bassin)	18%	25%	24%
North	23%	24%	24%
East	16%	8%	9%
South	9%	10%	9%
Female	96%	99%	98%
Age (mean)	55	48	49
Married	80%	76%	77%
French Education	73%	27%	35%
Received Training	77%	4%	17%
Unsatisfied Training Need	85%	53%	59%

Table 2: Means of Continuous Explanatory Variables

Variable	Non-Group Mean (Std. Dev.)	Group Mean (Std. Dev.)
Age	48 (12)	55 (10)
Distance between SME and nearest city (km)	1.0 (3.2)	2.5 (6.0)
Distance between SME and nearest cereal wholesale market (km)	1.6 (8.4)	7.4 (34)
Estimated value of training received (FCFA)	1,380 (20,900)	57,600 (161,000)
Average price of millet grain (per kg)	295 (67)	269 (72)
Average quantity of millet grain purchased (kg/month)	253 (604)	1,150 (3,170)
Average millet processing capacity (kg/month)	652 (2,050)	1,980 (2,460)
Average number of days of family labor per month	5.4 (11.2)	1.9 (7.1)
Average number of days of salaried labor per month	1.7 (6.9)	5.3 (10.9)
Average expenditure on family labor (FCFA/month) ($n_{nongroup}$=181 n_{group}=47)	7,030 (22,300)	31,700 (110,000)
Average expenditure on salaried labor (FCFA/month) ($n_{nongroup}$=181 n_{group}=47)	15,100 (50,800)	173,000 (311,000)

METHODOLOGY

- Stochastic Frontier Analysis
- Technical efficiency
  - Y_i is potential output for SME i, x_i is a vector of inputs and explanatory variables, β are the estimated parameters and ε_i is the composed error term
  - Production Function for SME *i*

$$Y_i = f(x_i, \beta) + \varepsilon_i \quad where \quad \varepsilon_i = v_i - u_i$$

  - Technical Efficiency Score for SME *i*

$$TE_i = \frac{Y_i}{\exp(x_i\beta + v_i)} = \frac{\exp(x_i\beta + v_i - u_i)}{\exp(x_i\beta + v_i)} = \exp(-u_i)$$

  - Technical Inefficiency term for SME *i*:

$$u_i = z_i\delta + \omega_i$$

- Allocative efficiency
  - E_i is expenditure of SME *i*, y_i is the output vector for SME *i*, w_i is the vector of input prices faced by SME *i*, and γ is a vector of parameters to be estimated
  - Cobb-Douglas functional form for cost frontier
  - Cost frontier for SME *i*:

$$\ln\left(\frac{E_i}{w_{ki}}\right) = \gamma_0 + \gamma_y ln y_i + \sum_{n\neq k} \gamma_n \ln\left(\frac{w_{ni}}{w_{ki}}\right) + v_i + u_i$$

  - Cost efficiency for firm *i*:

$$CE_i = \frac{c(y_i, w_i; \beta) * \exp(v_i)}{E_i} = \exp(-u_i)$$

RESULTS

Table 3: Select Coefficients for Techinical and Allocative Efficiency Estimations

Log millet transformation capacity	TE Regression	AE Regression
Log monthly quantity (kg) millet grain purchased (avg across seasons)	0.26***	-
Std. dev.	0.03	-
Log number of days of salaried labor	0.20***	-
Std. dev.	0.04	-
Log number of days of family labor	-0.06*	-
Std. dev.	0.03	-
Constant	4.87***	-
Std. dev.	0.15	-
Log sigma squared v		
Constant	0.15**	-
Std. dev.	0.05	-
Log sigma squared u (Technical Inefficiency)		
Literacy (omitted: can read and write in one language)		
Can read in one language	-0.48	-
Std. dev.	0.53	-
Can write in one language	-0.90*	-
Std. dev.	0.52	-
Age	-0.03**	-
Std. dev.	0.01	-

Table 4: Mean Technical Efficiency and Allocative Efficiency Scores

Technical Efficiency	TE Score	*n*
Mean TE Score (Non-Group)	0.62	699
Mean TE Score (Group)	0.78	134
Mean TE Score (All)	0.64	833
Allocative Efficiency	**AE Score**	***n***
Mean AE Score (Non-Group)	-	-
Mean AE Score (Group)	-	-
Mean AE Score (All)	-	-

DISCUSSION

- SMEs that belong to a group are more technically efficient than those that do not belong to a group
- Future research could look at:
  - What are the patterns and determinants of procurement, sales, and technology choices of second-stage women-operated processing SMEs? What are the outcomes of these choices in terms of profitability/incomes and resilience (in terms of variability of returns)?

FEED THE FUTURE The U.S. Government's Global Hunger & Food Security Initiative
USAID FROM THE AMERICAN PEOPLE
INNOVATION LAB FOR FOOD SECURITY POLICY RESEARCH, CAPACITY, AND INFLUENCE (PRCI)
MICHIGAN STATE UNIVERSITY
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE IFPRI