Understanding Rwandan Agricultural Households' Strategies to Deal with Prime Age Illness and Death: A Propensity Score Matching Approach

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Overall objective

Main research question:

- Are rural household adopting strategies in response to prime age adult illness and death that include changes in cropping patterns?
  - If so, what crops are affected and in what direction?

Additional research questions:

- Is it important to separately measure impacts during the period of illness and then after the death?
  - Implications of measuring period for interventions
- Is Propensity Score Matching a valuable approach?

Specific Objectives

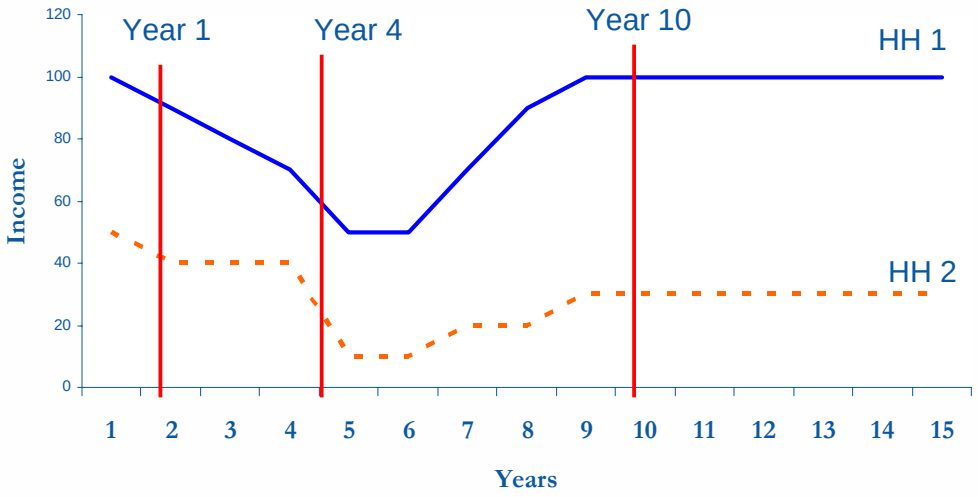
- Identify agricultural strategies of affected HHs
  - Strategies during illness versus strategies after a death
  - Gender dimensions of those strategies
- Evaluate the impact on agricultural production of key crops at a HH level
- Analyze implications of HH strategies/actions for interventions/programs
  - Compare those during illness versus after a death
- Evaluate how these results might affect estimates of agricultural sector impacts and intervention design

Time as an important dimension to impacts

- Household strategies differ across households but also over time (illness, death, post-death)
  - Demographics
  - Production system
  - Other aspects
- Community/society effects also over time (eg. Mtika)
- "Recovery" or poverty trap
  - Temporary shifts (rent out land, cultivate tubers)
  - Permanent shifts (take out tree crops, sell oxen)
- Agricultural production:
  - Seasonal labor demands/shortages
  - Differences between crops/ cropping systems
- Surveys measure households at specific points in time
  - Cross-sectional and longitudinal

When you measure counts

Impact over time: Hypothetical Households



Year 1= prior to illness; Year 4=illness, just prior to death; Year 10=5 years after death

Data

MINECOFIN households surveys (6000 hhs)

- **2001 Living Conditions Survey**

MINAGRI households surveys: (1500 hhs)

- **2000-2002 Seasonal Production data**
- **2001 Demographic data**
- **2002 Illness & Death data**

Earlier Analysis

- Affected hhs work to maintain labor in agriculture
  - new labor, hiring, sharing,
  - not shifting solely into labor-saving crops/technology
- Affected hhs more likely to be very poor ex post
- Strategies suggest some households are using strategies that results in a downward spiral into poverty (sales of productive assets)

Stated effects of mortality or morbidity on household agricultural activities

Adult death

- Reduced farm labor (59%)
- Reduced farm skills (9%)
- Lost access to land (6%)
- No effects stated (for those who have been inactive for at least a year or whose primary activity was non-ag) (25%)

Chronically ill adult

- Reduced farm labor (80%)
- Lost access to land (2%)
- Reduced farm skills (2%)
- No effects stated (for those who been inactive for at least a year or whose primary activity was non-ag) (25%)

Assessing effects: Comparing households with a shock to those without

Methodological approach for cross-section or panel data

- Propensity score matching:
  - Create a "propensity score"
  - $P(x_i)$ = Prob $(w_i=1|x_i)$ $\quad (0<P(x_i)<1)$
    - where
      - X_i are pre-death/illness control variables (predictors of illness or death due to illness)
      - W_i is (0,1) indicator for having illness or death in HH

- Use the estimated P score to match affected households with unaffected households who have "similar" probabilities and compare their outcomes

Effect on households: Change in production from 1999/2000 – 2001/2002, in kilograms produced

	Death HHS			Illness HHS		
CROP	**ATT**	**t**		**ATT**	**t**	
Beans	-6.89	-0.51		20.99	0.6	
Cassava	8.81	0.1		101.12	0.73	
Sweet Potatoes	-209.96	-1.26		467.88	2.45	**
Cooking Bananas	-78.58	-0.75		-102.65	-1.51	
Beer Bananas	-198.91	-3.01	***	-205.4	-1.82	*
Fruit Bananas	-41.17	-2.49	***	-35.81	-0.87	
Coffee	-4.97	-0.94		-9.31	-1.79	
Source: FSRP/DSA Surveys. Confidence levels: ***=0.01 ; **=0.05; *=0.1 .						
* Significant at 0.1 ; ** Significant at 0.01						

ATT is the Average Treatment effect on the Treated, based on Propensity Score Matching

Crop Shifts

- Less beer banana and less fruit banana (especially after a death)
  - Lower household incomes, particularly for women
  - Possible increase in erosion problems, depending on what enters the cropping system
- More sweet potatoes: (very strong impact during illness)
  - More dispersed labor demand
  - But erosive crop when planted on slopes (better than cassava though)
  - Calories and some nutrients
  - Not a great cash crop (marketing constraints)

Conclusions

- **Earlier evidence:**
  - Affected hhs: Maintain labor in agriculture
  - Affected hhs more likely to be very poor (ex post)
  - Demographic changes in an attempt to respond
  - Strategies of downward spiral into poverty evident for some (sales of productive assets)
- **New Empirical Evidence**:
  - Different changes in production evident between illness, death and control households
  - Changes suggest that incomes are declining and subsistence production increasing in the illness period
  - Analysis must be careful to evaluate at different times to help design interventions for before households make irreversible steps of removing trees and selling assets.
  - Propensity Score Matching is a valuable approach, but should be complemented with other methods.

Annex 1:
ATE: estimator of the mean impact of the treatment is

$$\Delta Y = \sum_{i=1}^{T} w_i \left(y_{i1} - \sum_{j=1}^{C} w_{ij} y_{ij0} \right)$$

–where

- y_{i1} is post-shock outcome for hh_i (eg. Total crop production)
- y_{ij0} is outcome of jth non-treated matched to the ith treated
- T is total number of treatments
- C is total number of non-treated households
- W_i's are the sampling weights to construct mean impact indicator
- W_{ij}'s are weights applied in calculating average outcome of matched non-participants

Comparisons of Households in 1999/2000

	HH w/ Death	Control HH	HH w/ Illness	Control HH
Characteristics of Head prior to event*				
Proportion Female	0.5	0.31	0.29	0.31
Head is either married or separated (1999)	0.23	0.42	0.6	0.47
Age of pre-treatment head in 1999	43	42	41	43
Household level variables prior to event				
Household has received remittances	na	na	0.6	0.57
Distance to primary market (km)	1.83	1.71	2.4	1.77
Total income in 2000	na	na	141058	159603
Length of residence in cellule	10.44	9.4	7.83	8.27
N	78	1051	65	761

*Some data imputed. Control households represent households were matched using Propensity Score Matching, radius of 0.01.