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What we can learn about smallholder farmers from surveys: Results from EPAR analysis of the Tanzania National Panel Survey

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Gender Matters

Mean Value of Maize Sales by Gender of Household Head- Long Rainy Season

Mean Hours of Household Labor, Last 7 Days

- Female-headed households had fewer plots, smaller landholding sizes, and grew fewer crops than male-headed households.
- Female-headed households made an average of $56 and $112 from maize and paddy sales and male-headed households made an average of $97 and $239.
- Adult women spent more than three times the number of hours as adult men on unpaid non-farm household business in both agricultural and non-agricultural households. In agricultural households men spent slightly more time and women spent slightly less time on these activities than in non-agricultural households.

What is the TNPS?

The Tanzania National Panel Survey (TNPS) is part of the World Bank's Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS – ISA) funded by the Bill & Melinda Gates Foundation (BMGF). The LSMS – ISA covers 7 Sub-Saharan African countries and interviews the same households multiple times to produce panel data. The surveys collect detailed information about agriculture and socio-economic indicators. The primary goal of the project is to "foster innovation and efficiency in statistical research on the links between agriculture and poverty reduction in the region."

The TNPS is implemented by the Tanzania National Bureau of Statistics (NBS). Most of EPAR's analysis is based on the first round of data, which were collected over a twelve-month period from October 2008 through September 2009. The sample design was constructed to produce nationally representative estimates, and it consists of 3,265 households, 2,474 of which are agricultural households. Data was collected at multiple levels: communities, households, plots, individuals, and crops & animals.

TNPS Briefs

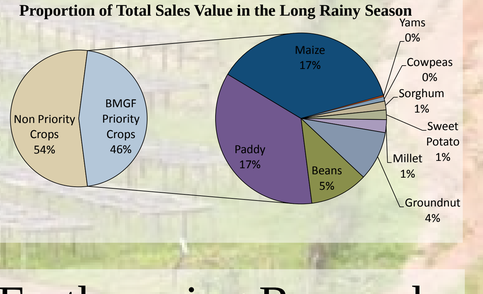
EPAR Research Assistants and Principle Investigators C. Leigh Anderson and Mary Kay Gugerty have produced eight publically available briefs based on analysis of the TNPS.

- **Sorghum and Millet** (Elysia Slakie, Caitlin McKee, Angela Gaffney, Mary Kay Gugerty, & C. Leigh Anderson)
- **Market Access** Elysia Slakie, Kathryn Bergh, Amy Pennington, C. Leigh Anderson, & Mary Kay Gugerty)
- **Legumes** (Katie Stahley, Elysia Slakie, Karina Derksen-Schrock, Mary Kay Gugerty, & C. Leigh Anderson)
- **Paddy** (Rice) (Kathryn Bergh, Justin Pausen, Karina Derksen-Schrock, Mary Kay Gugerty, & C. Leigh Anderson)
- **Maize** (Katie Stahley, Elysia Slakie, Karina Derken-Schrock, Mary Kay Gugerty, & C. Leigh Anderson)
- **Gender** (Claire Kpaka, Amy Pennington, C. Leigh Anderson, & Mary Kay Gugerty)
- **Inputs** (Rico Natali, Alexander Chew, Amy Pennington, Karina Derksen-Schrock, C. Leigh Anderson, & Mary Kay Gugerty)
- **Drivers of Inorganic Fertilizer Use in Tanzania: A Comparison of the TZNPS and FF Datasets** (Katie Stahley, Amy Pennington, C. Leigh Anderson, & Mary Kay Gugerty)

Markets Matter

- Paddy was the most commonly sold of the priority crops, with 52% of paddy farming households selling an average of 51% of their harvest in the long rainy season. Sorghum was least commonly sold; only 15% of households that grew sorghum sold an average of 51% of their yields. Thirty-four percent of maize growing households sold an average of 38% of their harvests.
- Of the priority crops, paddy and legumes (beans, groundnuts, and cowpeas) received the highest price per kilogram and paddy sellers received on average, the highest amount for sales of all priority crops.
- Few farmers stored or processed harvested crops for sale. Of farmers storing their maize harvest in the long rainy season, only 4% reported storing it to sell at a higher price; the vast majority (94%) stored it for food. Eighty-three percent of agricultural households that grew crops processed one or more of those crops in some way (into flour, seeds, maize bran, etc.), but only 9% of these households sold the resulting product.
- Though four other priority crops were more likely to be sold, maize was the most commonly grown crop in the country (83% of households), and it accounted for the largest proportion of sales value among priority crops in the long rainy season. Although only 17% of households cultivated paddy, it contributed nearly the same sales value as maize in the long rainy season due to its high sales price. Tobacco (18%), cotton (12%), sunflower (4%), Irish potato (3%), and onions (3%) made up the majority of the value sold of non-priority crops.

Proportion of Total Sales Value in the Long Rainy Season



Challenges and Lessons from Working with the TNPS

Interpreting survey results from a raw dataset is a **balance of science and art**. When presented with data limitations or ambiguity, we employ sound analytical methods and judgment to draw key findings. **Examples of challenges we encounter and approaches to address them include:**

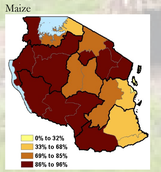
- **Survey estimates do not always match** estimates calculated by reputable institutions. For example, our TZNPS yield estimates tend to be lower than estimates from the UN Food and Agriculture Organization (FAO).
- **Results sometimes contradict consensus** in the literature. For example, the effects of intercropping are less significant than the literature suggests. Thus, **we rely on theory** to guide our hypotheses and data manipulation, but we are also **open to new conclusions.**
- **Survey questions and response options are sometimes ambiguous.** For example, when farmers' perceptions of soil quality from the survey are unclear, we incorporate remote satellite soil data quality information from the Harmonized World Soil Database to provide a more nuanced understanding of farmers' soil quality.
- **Medians provide a better representation** of the typical Tanzanian farmer than means, but means are useful for determining statistical differences between groups. We select **the most appropriate central measure** for each types of analysis and report both in our appendices.
- **There is no common procedure for removing outliers from this dataset,** so we establish different data cleaning methods such as excluding the top 1% of observations depending on the meaning of the variables.

Crops in Tanzania

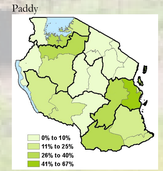
- The BMGF Agricultural Development initiative focuses primarily on 10 priority crops in Sub-Saharan Africa: maize, rice, cassava, sorghum, millet, beans, groundnuts, sweet potatoes, yams, and cowpeas. We analyzed the survey data to learn more about these crops, as well as other crops important to smallholder farmers in Tanzania.
- Maize was the predominant crop cultivated in Tanzania, with 83% of agricultural households growing maize during the long or short rainy season. Cassava was the second most commonly grown crop, cultivated by 35% of households. Beans, bananas and mangos were each cultivated by just over a third of households. Seventeen percent of households in Tanzania grew paddy, and cultivation varied substantially by region.

Proportion of Households Cultivating Maize, Paddy and Cassava by Region

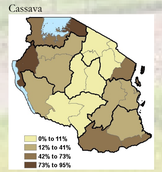
Maize



Paddy

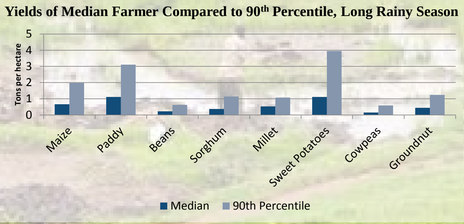


Cassava



- For all priority crops, median yields were substantially lower than yields in the 90th percentile, suggesting potential for improved yields.

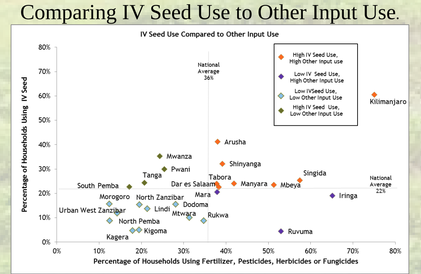
Yields of Median Farmer Compared to 90th Percentile, Long Rainy Season



Inputs Matter

- Nationally, a minority of farmers used inputs during the long and short rainy seasons, with 22% of agricultural households using an improved variety (IV) seed and 36% using some type of fertilizer, pesticide, herbicide, or fungicide.
- Approximately one third of agricultural households spent no money on IV or traditional seed, fertilizer, pesticides, herbicides or fungicides during the long and short rainy seasons. Of those that did purchase these inputs, the median expenditure was USD$10.43.
- The figure at right is a plot of regional IV seed use compared to the use of at least one other input (organic fertilizer, inorganic fertilizer, and/or pesticides, herbicides or fungicides). The data show a statistically significant, positive correlation between improved seed use, and the use of all other inputs at the household level. Ten out of 25 regions showed below average input use in both categories, many of these regions were coastal.

Comparing IV Seed Use to Other Input Use.



Forthcoming Research

Intercropping

Intercropping, or planting more than one crop in close proximity to another in an interspersed manner, is practiced by over 80% of Tanzanian households. The survey results support that intercropping has the potential to improve soil health because intercropped plots planted with legumes had higher land and labor productivity than monocropped plots. However, only 59% of intercropped plots in the long rainy season were planted with legumes and few respondents identified soil health as the primary reason for intercropping.

Crop Diversity

The mix of crops cultivated by smallholder farmers in Tanzania shows substantial regional variation, but does this mix change substantially over time? Using two panels of the LSMS-ISA data from 2008-2010, we will investigate the extent to which the mix of crops cultivated has changed, and attempt to identify the socioeconomic, climactic, and regional policy factors that may influence farmer crops selection decisions. The goal of analysis will be to answer the following two research questions:

- What is the substitution among cereal staples (e.g. would a household switch from sorghum to millet?)
- What is the substitution between cereal staples and minor crops (e.g. would a household reduce their plot diversity and intercropping to plant more staples?)

Yield Measurement

Increasing farm productivity is a common strategy to improve rural livelihoods and support general economic development. Measuring productivity to strategically identify areas for investment typically relies on yield estimates. While there are several recognized measures and various methods of collecting data, research often presumes "yield" has a single, well-understood definition. When yield measurement is specified, it is often defined as weight harvested divided by area harvested. Information from the Tanzania National Panel Survey (TZNPS) on rice plots suggests that smallholder farmers frequently experience a loss in area between planting and harvesting. Comparing OLS regressions on two different measures of yield (by area planted and by area harvested) suggests different drivers of yield and thus different policy implications depending on the yield measurement method. Our findings suggest that researchers should consider measuring yield by area planted to best identify where to direct resources to improve small scale farmer productivity.

Evans School Policy Analysis and Research Group (EPAR)

The Evans School Policy Analysis and Research Group (EPAR) provides research and policy analysis to support the work of the Agricultural Policies team at the Bill & Melinda Gates Foundation (BMGF).

This unique partnership gives graduate students and faculty at the Evans School the opportunity to engage in research projects supporting the strategic goals of the Gates Foundation's Agricultural Development initiative, particularly in Sub-Saharan Africa and South Asia. These projects include conducting literature reviews, performing data analyses, and preparing briefings on agricultural development and related topics.

Since the beginning of this partnership in fall 2008, EPAR has prepared more than 200 research reports for members of the Agricultural Development initiative at the Gates Foundation. These reports are diverse in their subject matter, ranging from examining women's role in the production of various crops to exploring the use of improved variety seeds and fertilizers.

In addition, EPAR has helped develop data tools and advance communication with Gates Foundation partners. EPAR's research work has touched on issues that are at the forefront of agricultural development and poverty alleviation strategies currently implemented by the Gates Foundation and its partners in Sub-Saharan Africa and South Asia.

Learn more about the faculty, staff, and students involved in EPAR and view EPAR's research at: http://evans.uw.edu/centers-projects/evans-policy-analysis-research-group .

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