# Tanzania National Panel Survey

LSMS-ISA: Maize

Maize was the Predominant Cereal Crop in Tanzania

Maize was the most commonly grown crop in Tanzania – cultivated by 83% of farming households. Eighty-two percent of agricultural households reported consuming maize flour during the week prior to being surveyed. About half of those households grew nearly all of the maize they consumed, making maize production an integral part of the farming household diet. The following analysis focuses on long rainy season[1] maize cultivation, which comprised 86% of the estimated total value of Tanzania's maize production. Short rainy season maize cultivation, relevant only for the north and northeastern regions of Tanzania, is addressed at the end of the brief.

The proportion of households cultivating maize varied by zone, but in all zones except Zanzibar, more than two-thirds of

Figure 1: Proportion of Households Cultivating Maize
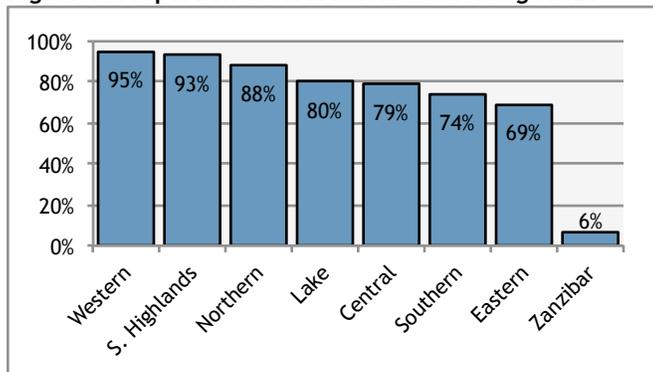
1 The majority of Tanzania has one long rainy season that typically lasts from December through April. The north and northeastern parts of the country have a long rainy season lasting from March through May and a short rainy season with lighter rainfall from October to December (Minot, N. (2010). *Staple food prices in Tanzania*. Washington, D.C. International Food Policy Research Institute).

> **KEY FINDINGS**
>
> - Maize was the most commonly grown crop in Tanzania, cultivated by 83% of households in the 2008 agricultural season.
>
> - The most productive plots (yields at the 90th percentile) harvested 203% more maize than plots with median yields.
>
> - Plots with improved variety seed and inorganic fertilizer had average yields 115% higher than plots without improved inputs before controlling for other factors such as plot size, farmer education, etc.[1]
>
> - Maize made up more than a third of the total estimated value of long rainy season crops grown in Tanzania during 2008.
>
> - Twenty-eight percent of households growing maize sold at least part of their harvest.
>
> 1 Statistically significant at p< 0.0000.

farming households grew maize during the long or short rainy season (see *Figure 1*). In Zanzibar, where cassava and paddy were the primary crops, only six percent of households grew maize. Male and female-headed households were equally likely to grow maize in all zones.

Yield Gap Analysis Suggests Yields were Low Relative to Potential

The gap between the median harvested plot yield of 0.66 t/ha and the 90th percentile plot yield of 2.00 t/ha suggests that many farmers could potentially achieve higher yields.[2] *Figure 2* shows the distribution of plot yields (t/ha) in Tanzania.

Median plot yields were highest in the Southern Highlands and lowest in the Southern and Lake zones (see *Map 1*). *Figure 3* shows the yield gap by zone. With the exception of the Central and Southern Highlands zones, yield gaps were 200% or greater.

2 The 2008 FAO estimate for Tanzania maize yields was 1.25 t/ha.

Figure 2: Plot Yield Distribution
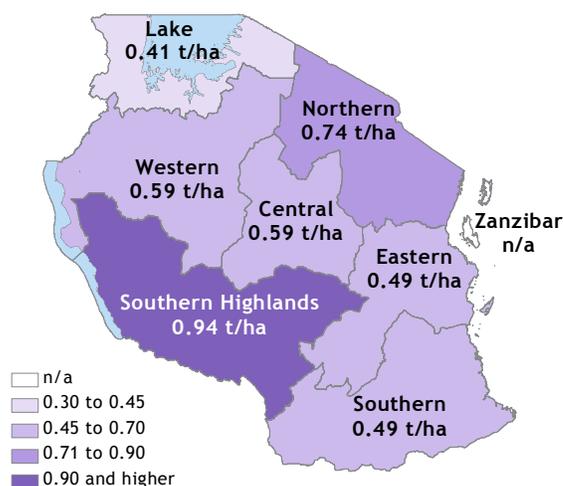

Map 1: Median Yields by Zone
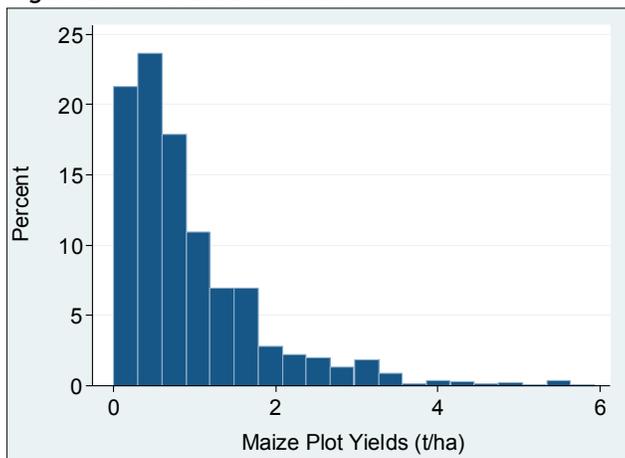
Plots of male-headed households yielded a median of 0.71 t/ha, significantly more than plots of female-headed households, whose yields were 0.59 t/ha.[3] This gap may be at least partly explained by differing levels of input use, discussed below.

Smaller plot sizes were correlated with higher yields, consistent with other studies. Maize plots that were 0.81 hectares or larger yielded an average of 0.84 t/ha, whereas plots smaller than 0.81 hectares averaged 0.98 t/ha before controlling for other plot and household characteristics.[4]

Low Input Use was Associated with Low Yields

Though more maize plots were sown with improved variety (IV) seeds than any other crop, IV seed use was limited to only 16% of maize plots. Fungicide, herbicide, and/or pesticide use on maize plots was even lower at 11%. Female-headed households were significantly less likely than male-headed households to

use IV seeds (12% versus 18%). They were also less likely to use inorganic fertilizer on their plots, although not significantly so, and organic fertilizer use was nearly equal.[5]

The plots on which farmers used IV seed or fertilizer generally yielded significantly more maize. *Figure 4* compares the TZNPS mean yields based on input use. Maize plots with no IV seed or fertilizer inputs yielded an average of 0.80 t/ha, while plots using IV seed without fertilizer averaged yields of 0.89 t/ha, though this difference was not statistically significant. Inorganic fertilizer used without IV seed significantly increased yields from the 0.80 t/ha baseline to 1.16 t/ha, and organic fertilizer used without IV seed increased yields to 1.20 t/ha.[6] On the 55 plots on which inorganic fertilizer and IV seed were both employed, mean yields reached 1.71 t/ha. Plots with both organic fertilizer and IV seed, however, resulted in low yields of 0.78 t/ha.[7] This suggests that the appropriate use and combinations of fertilizer and IV seed could contribute to closing the yield gap.

Figure 3: Plot Level Yield Gap by Zone
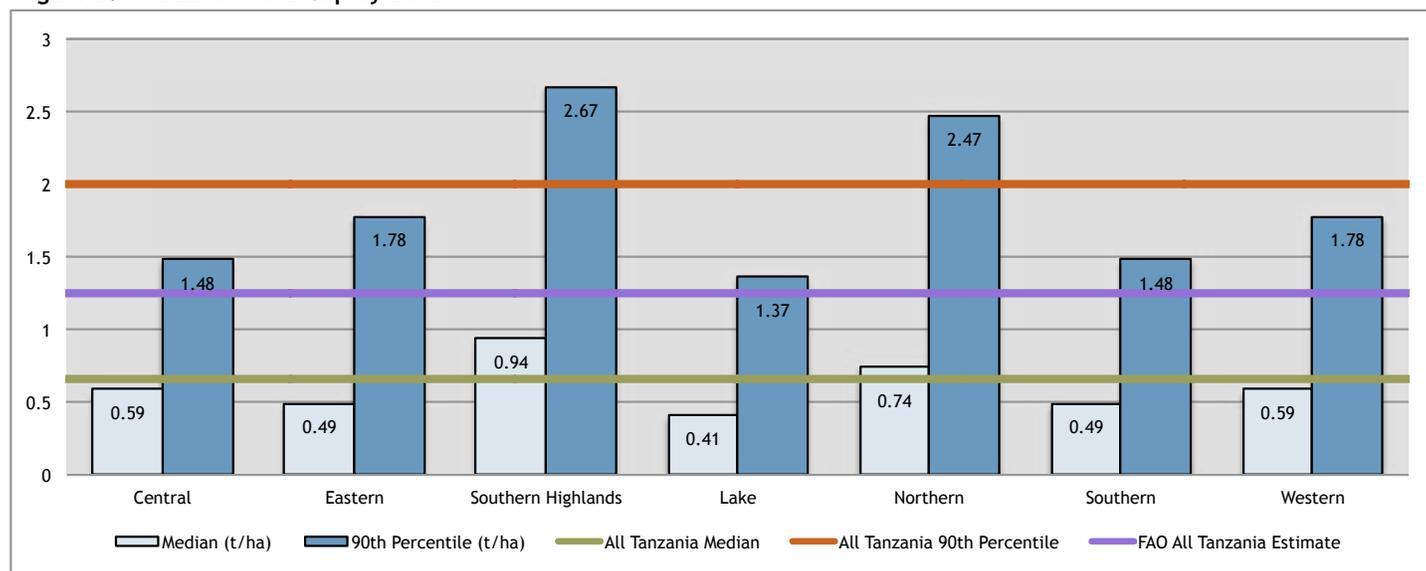
3 Mean yields for male- and female-headed households were 0.94 t/ha and 0.84 t/ha, respectively, statistically significant with p<0.0553.
4 P< 0.007.

5 IV seed p< 0.0293; inorganic fertilizer p< 0.1376; organic fertilizer p< 0.7218.
6 Inorganic fertilizer p< 0.0019; organic fertilizer p< 0.0000.
7 This may be due to a low number of observations (40 plots).

Maize farmers also lacked adequate agricultural tools and equipment. While most farming households owned one or more hoes, ownership of other farm implements was rare. Farmers reported that they were unable to fully plant 12% of maize plots due to input constraints, and the lack of agricultural tools or equipment was reported as the main cause.

Pre-Harvest Losses Widened the Yield Gap

Median and 90th percentile yields were lower when calculations were based on area planted rather than area harvested, indicating that farmers may have suffered from substantial pre-harvest losses.[8] Farmers reported harvesting less area than they planted on 30% of maize plots. More than half attributed the loss of harvestable area to drought (see *Figure 5*). In addition to the loss in harvestable area, farmers reported pre-harvest losses on 34% of plots, primarily due to animals, theft, and insects.[9] In comparison, post-harvest losses were reported by 14% of households, and over half of these were due to rodents and pests.

Figure 4: Average Plot Yields Estimated by Input Use

Figure 5: Reasons for Harvesting Less Area than Planted
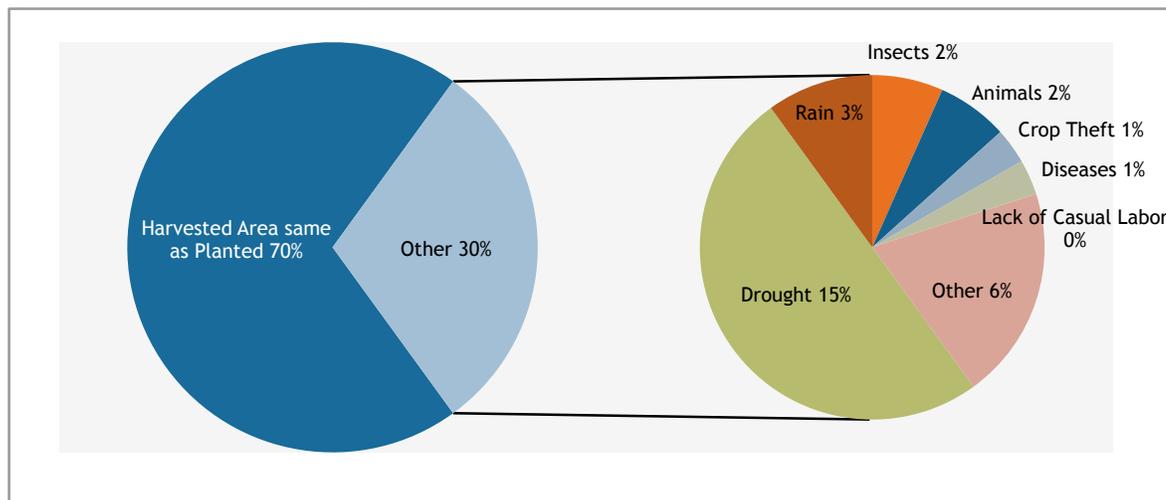
High Producing Plots

Plots with yields at the 90th percentile or higher had significant differences from lower yielding plots. These high yielding plots were more likely to be cultivated in loam soil,[10] more likely to use inputs,[11] and were, on average, smaller than lower yielding plots.[12] *Figure 6* compares input use on high yielding plots to input use on plots yielding less than the 90th percentile.

Maize was Widely Intercropped

Sixty-five percent of long rainy season maize plots were intercropped. Intercropped plots yielded less maize per hectare at harvest (0.84 t/ha compared to 1.06 t/ha), but these yields do not account for lower plant density (not reported in the TZNPS), or the yields of the intercropped crop. Although only 4% of crops were reportedly intercropped for soil enhancing purposes, the top three intercropped crops (cowpeas, beans, and groundnuts) are nitrogen fixing and may improve soil health. The land and labor productivity of intercropped maize plots was higher than non-intercropped plots, though not at statistically significant levels.

8 See *Appendix T* of Section D of the *Tanzania LSMS-ISA Reference Report* for a full description of the differences between the area planted and area harvested yield variables.
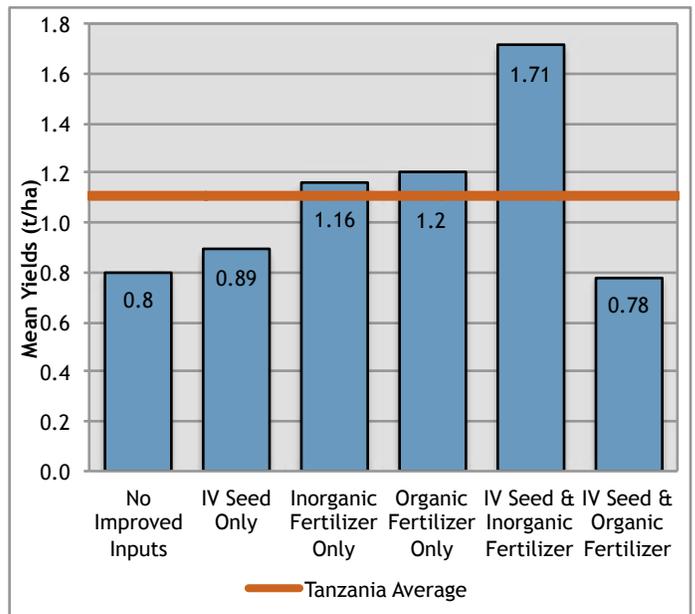9 Farmers were asked two separate questions: *Was the area harvested less than the area planted?* and *Were there any losses of crops before the harvest?* Some farmers reported losses for both questions and it is possible that some farmers reported the same losses twice.
10 $P<0.0001$.
11 Any input $p<0.0000$; any fertilizer $p<0.0000$; inorganic fertilizer $p<0.0068$; organic fertilizer $p<0.0001$; herbicide/pesticide $p<0.0021$.
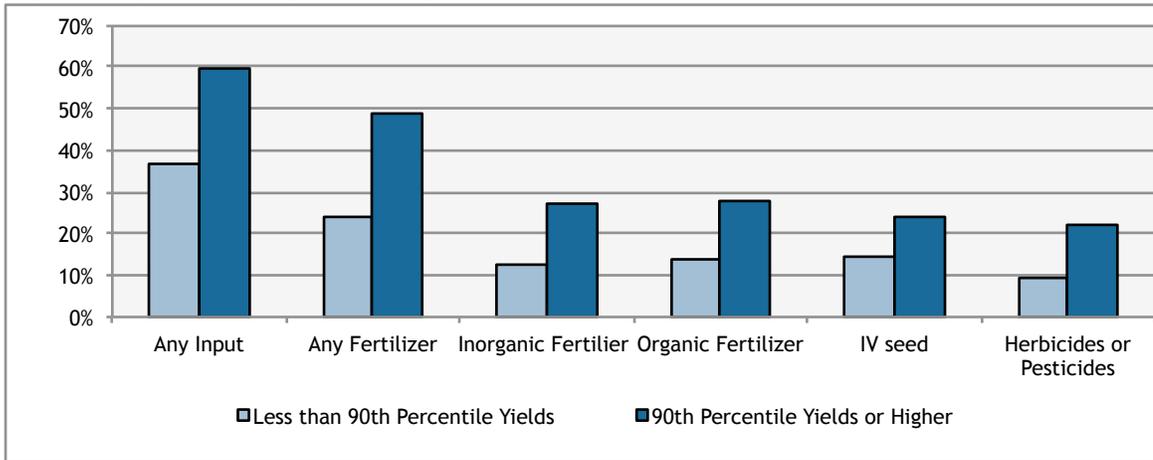12 $P<0.0116$.

Figure 6: **Input Use on High-Producing Plots**

Legend: ☐ Less than 90th Percentile Yields ■ 90th Percentile Yields or Higher

Fewer than One Third of Households Sold Maize

Maize harvests comprised about 34% of the total value of Tanzania's long rainy season crops in 2008 (*Figure 7*). Twenty-eight percent of households sold a portion of their long rainy season maize yields. The proportion of households selling maize varied from 17% in the Eastern Zone to 43% in the Southern Highlands, where farmers also cultivated the highest yielding plots.[13]

The average household revenue received from maize sales for the long rainy season harvest was USD$89, though this varied between male- and female-headed households. Whereas 31% of male-headed households sold maize for an average value of USD$97, only 21% of female-headed households sold maize and received an average value of USD$56.

Figure 7: **Estimated Value of Maize as a Proportion of Seasonal Crops**

Legend: ■ Value of Other Crops (Millions of US$) ■ Value of Maize Crop (Millions of US$)
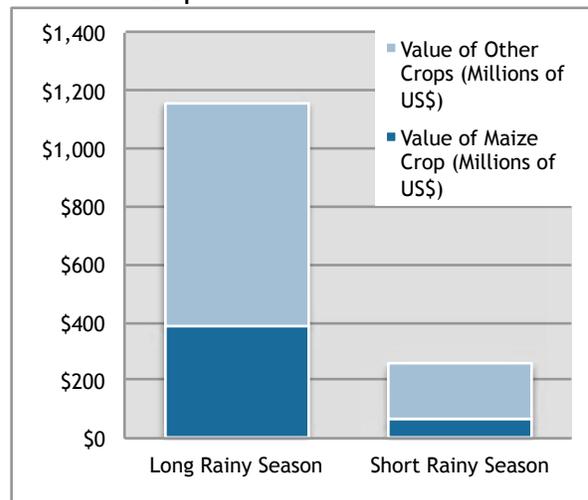
Short Rainy Season Maize

Long rainy season maize is grown consistently throughout the country and comprises most of Tanzania's maize production. Only the north and northeastern regions of Tanzania have a short rainy season. *Figure 7* shows that short rainy season crops made up much less of the total estimated agricultural value in Tanzania than long rainy season crops. Maize grown during the short rainy season made up only 4% of total estimated value of crops grown in the long and short rainy seasons.

Table 1 compares long and short rainy season maize. Generally, plots cultivated during the short rainy season yielded less and received a lower price than long rainy season maize plots.

Table 1: **Comparison of Long Rainy Season and Short Rainy Season**

	Long Rainy Season	Short Rainy Season
Mean Yields (kg/acre)	0.80 t/ha	0.60 t/ha
Proportion of Households that Sold Maize	28%	17%
Average Price per kg	$0.19	$0.17
Pre Harvest Losses	34%	39%
Proportion of Plots Using:		
Improved Variety Seed	16%	15%
Organic Fertilizer	16%	16%
Inorganic Fertilizer	16%	4%
Pesticides, Herbicides, Fungicides	11%	4%

13 Zanzibar is excluded for insufficient observations (less than 30).

Strategic Implications and Outstanding Questions

Households in Tanzania were more likely to cultivate maize than any other crop and it was a staple food in most of the country. The large gap between the median and 90th percentile plot yields suggests an opportunity to increase yields. Given the importance of maize in both production and consumption, yield increases could play an important role in poverty reduction; however, additional information on the distribution of net maize purchasing versus net maize producing households would be helpful.

Analysis of TZNPS survey data suggests that addressing low input use and relatively high pre-harvest losses may be useful approaches. Given the widespread prevalence of intercropping, a better understanding of intercropping practices and strategies may be an important component of any strategy to increase maize yields and productivity.

High yielding plots (90th percentile yields or higher) were twice as likely to use fertilizers and pesticides/herbicides and were significantly more likely to use IV seed. While this suggests that promoting input use may lead to higher yields, 41% of high yielding plots used no inputs (fertilizer, IV seed, or herbicides/pesticides). In addition, zonal variation in yields was high, suggesting that cultivation practices, soil quality and other agro-ecological factors play a large role in determining yields. For example, high yielding plots are more likely to be cultivated on loam soil. In addition, the survey data did not provide sufficient evidence on the specific types or quality of inputs or on application rates, so further evidence on these factors would contribute to a better understanding of the determinants of yields.

Reducing pre-harvest losses could also improve yields. Many farmers reported harvesting less area than they planted and losing substantial portions of their maize crops before harvest. Farmers reported that the main reason they harvested less area than they planted was drought, indicating a potential opportunity for drought-resistant seed.

Finally, while maize was widely cultivated in both male- and female-headed households, female-headed households were less likely to use IV seeds or inorganic fertilizer and had lower average yields than male-headed households. Since 25% of agricultural households in Tanzania are female-headed, this represents substantial lost production and an opportunity to address a potentially important gender gap.[14]

14 EPAR Brief #190, "Tanzania National Panel Survey LSMS-ISA: Gender" explores these issues in more detail.

Please direct comments or questions about this research to Leigh Anderson and Mary Kay Gugerty, at eparx@u.washington. edu.

This brief presents summary statistics from the Tanzania National Panel Survey (TZNPS), which was implemented by the Tanzania National Bureau of Statistics, with support from the World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) team. The LSMS-ISA data 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 from eight administrative zones, each with a rural/urban cluster, for a total of sixteen sampling strata. The resulting data can produce nationallly representative estimates at the national and zonal level. Sample size limitations preclude reliable statistics at the regional or district level. Agricultural households completed an additional farm questionnaire, resulting in 2,474 respondents who report involvement in any crop, fishing or livestock cultivation.

In 2011 EPAR completed the Tanzania LSMS-ISA Reference Report, a document consisting of eight sections that highlights specific areas such as crops and productivity, livestock, and inputs. The Reference Report provides summary statistics, detailed information on EPAR's methodology for analysis, and the opportunities and challenges that the LSMS-ISA survey data present. Please refer to the Section A: Introduction and Overview and Section D: Crops and Productivity of the Reference Report for more information on the data and analytical methodology used in this brief.

An appendix with confidence intervals and number of observations for all data in this brief is available upon request. While LSMS-ISA data was collected in kilograms and acres, we have converted units to metric tons (t) and hectares (ha) for this brief. One hectare = 2.47 acres and 1 t = 1000 kg.