Tanzania National Panel Survey
Living Standards Measurement Study - Integrated Surveys on Agriculture
INPUTS

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Tanzania National Panel Survey

LSMS-ISA: Inputs

National Input Use

According to the Tanzania National Panel Survey (TZNPS), a minority of farmers used inputs during the survey period.[1]

Table 1: **Input use in Tanzania in the Long and Short Rainy Seasons**

Input	% of Households Using Input	Median Household Expenditure*	Median Household Use(kg/ha)
Inorganic Fertilizer	13%	$39.62	71.5
Pesticides, Herbicides or Fungicides	15%	$8.34	1.1
Organic Fertilizer	22%	$8.34	644
Improved Variety(IV) Seed	22%	$7.51	NA
At least one input	45%	-	-

Median expenditure is for those who purchased input

Input and IV Seed Use Were Concentrated in the Northern and Southern Highlands Zones

Maps 1 through 4 show that patterns of input use varied widely by region. However, sample size limitations preclude reliable statistics at the regional level. Use patterns did not conform to larger administrative zonal boundaries (shown in black), in part because these zones do not align perfectly with agro-ecological zones. Although agricultural input use patterns did not follow administrative zonal boundaries, they are strategically relevant as a lens through which the Ministry of Agriculture makes agricultural policy.

1 Survey participants were asked about the 2008 long rainy season and the last completed short rainy season (either 2007 or 2008).
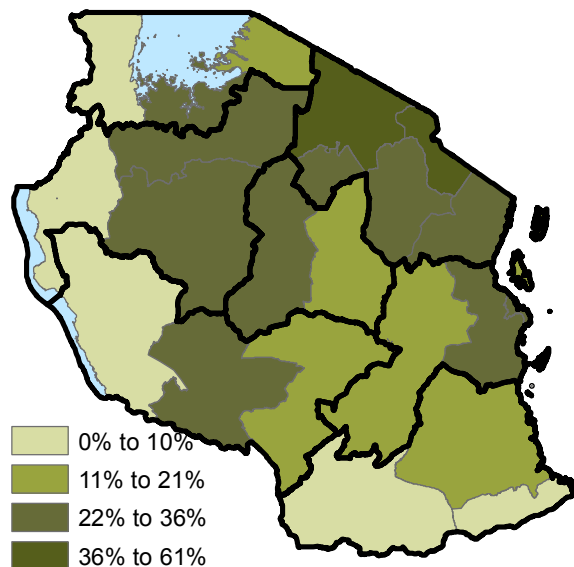
KEY FINDINGS

- 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.

- Maize was by far the most commonly cultivated crop in Tanzania. As a result, maize input use patterns heavily influenced the patterns of input use.

- 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.

- Patterns of agricultural input use varied widely by region.

- The region of Kilimanjaro had the highest proportion of households using IV seed, organic fertilizer, and pesticides, herbicides or fungicides.

- Receiving advice from an extension officer, education of household head, and expenditure on hired labor were each positively associated with the use of IV seed, inorganic fertilizer, and pesticide, herbicide, or fungicide.

GEOGRAPHIC INPUT USE PATTERNS

- IV seed use was concentrated in northeastern and central regions.

- Inorganic fertilizer use was concentrated in southern regions.

- Pesticide, herbicide or fungicide use showed no clear regional patterns.

- Organic fertilizer use was lowest in the southeastern regions.

At the national level, only 13% of households used inorganic fertilizer in the long and/or short rainy seasons. The Southern Highlands zone had the highest proportion of households using inorganic fertilizer (34%), driven primarily by high use in the Iringa and Mbeya regions. The neighboring region of Ruvuma in the Southern Zone also had relatively high proportions of inorganic fertilizer use (40%). These three high-fertilizer using regions are also considered to be part of the "breadbasket" of Tanzania. Kilmanjaro, in the Northern Zone, also had comparatively high proportions of households using inorganic fertilizer. In all other regions, 17% or fewer households used inorganic fertilizer.

Map 1: **Inorganic Fertilizer Use**

- 0% to 4%
- 5% to 10%
- 11% to 17%
- 18% to 49%

Map 2: **IV Seed Use**

- 0% to 10%
- 11% to 21%
- 22% to 36%
- 36% to 61%

use was almost exclusively herbicide (92%). In Kilimanjaro it was roughly 75% herbicide use and 25% pesticide use. In both regions, fungicide use accounted for less than 2%.
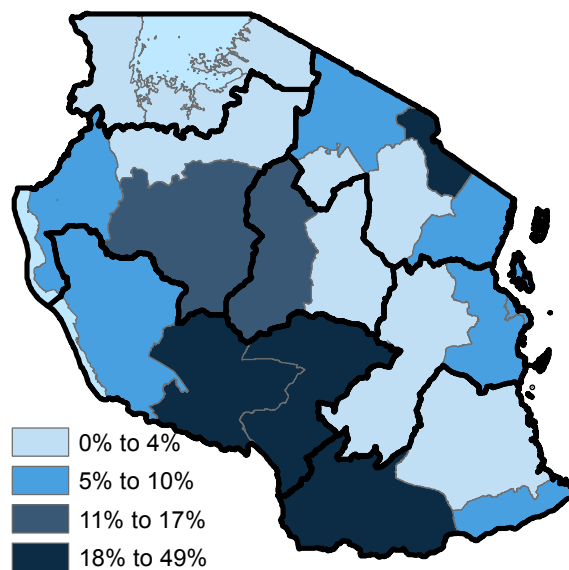
Nationally, only 22% of households used at least one IV seed variety during the survey period. The Northern Zone had the highest estimated proportion of households using at least one type of IV seed (39%), driven primarily by the Arusha and Kilimamjaro regions. The Western Zone had the second highest proportion of households (22%), driven by the Shinyanga and Tabora regions. The Southern Zone and Zanzibar had the lowest proportion of households purchasing IV seed (9% and 14%).

IV seed use was the only category of input use in which the three regions that make up the "breadbasket" were below the national average. The analysis of maize yields below indicates that plots using both IV seed and inorganic fertilizer yielded almost 50% more on average than those that used only inorganic fertilizer. In light of this, increasing IV seed use in the "breadbasket" may represent an opportunity to increase yields.

Nationally, 15% of farmers used at least one pesticide, herbicide or fungicide during the survey period. The Southern Highlands and the Northern Zones had the highest proportion of households using pesticides, herbicides or fungicides in the long and/or short rainy seasons (both with 22%). Kilimanjaro and Iringa had the highest rates of use for pesticide, herbicide, or fungicide with 40% and 32% respectively. In Iringa, the

Map 3: **Pesticide, Herbicide, and Fungicide Use**

- 0% to 5%
- 6% to 18%
- 19% to 31%
- 32% to 40%
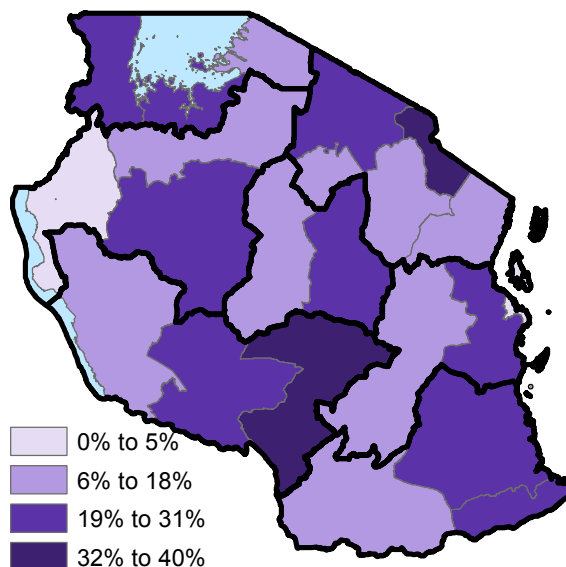
Twenty-two percent of farmers used organic fertilizer in the long and/or short rainy seasons. Organic fertilizer was more commonly used than inorganic fertilizer in six out of eight zones, and more commonly used than pesticides, herbicides or fungicides in all zones. The zone with the highest proportion of households using organic fertilizer was the Northern Zone (34%) with Kilimanjaro again being the region with the highest proportion of input users. The Singida region in the Central Zone had the second highest proportion using organic fertilizer. The southeastern part of Tanzania had very low organic fertilizer use rates with four regions under 7%.

One factor influencing organic fertilizer use may be the presence of cattle to produce manure. The Northern Zone had the highest proportion of cattle owning households as well as the strongest correlation between cattle ownership and organic fertilizer use.[2] This feature of the Northern Zone may be explained by a regional farming system in which many smallholder farmers keep cattle. In other zones the correlation between organic fertilizer use and cattle ownership was weaker.

IV Seed Use Was Positively Correlated with the Use of Other Inputs

Figure 1 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 plot is broken into quadrants to show how regional input use compared to national input use.

◆ **Low IV seed and other input use:** Ten out of the twenty-five regions[3] exhibited below average input use in both categories. Many of these were coastal regions: three out of the five regions in Zanzibar (Urban West Zanzibar, North Zanzibar, North Pemba) and two out of three regions in the Southern Zone (Mtwara and Lindi) fell into this category.

Map 4: **Organic Fertilizer Use**

- 0% to 6%
- 7% to 22%
- 23% to 37%
- 38% to 54%

◆ **Low IV seed use and high other input use:** Three out of twenty-five regions had lower than average IV seed use rates, but higher than average usage of other inputs. Of the three, two (Iringa and Ruvuma) were high-yield regions with relatively low IV seed use.
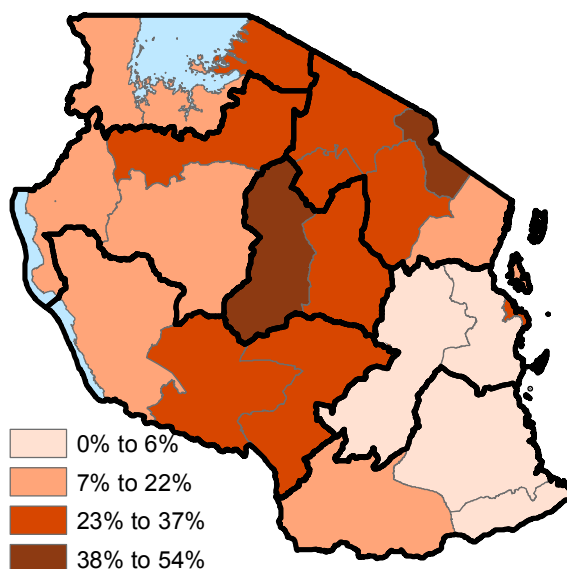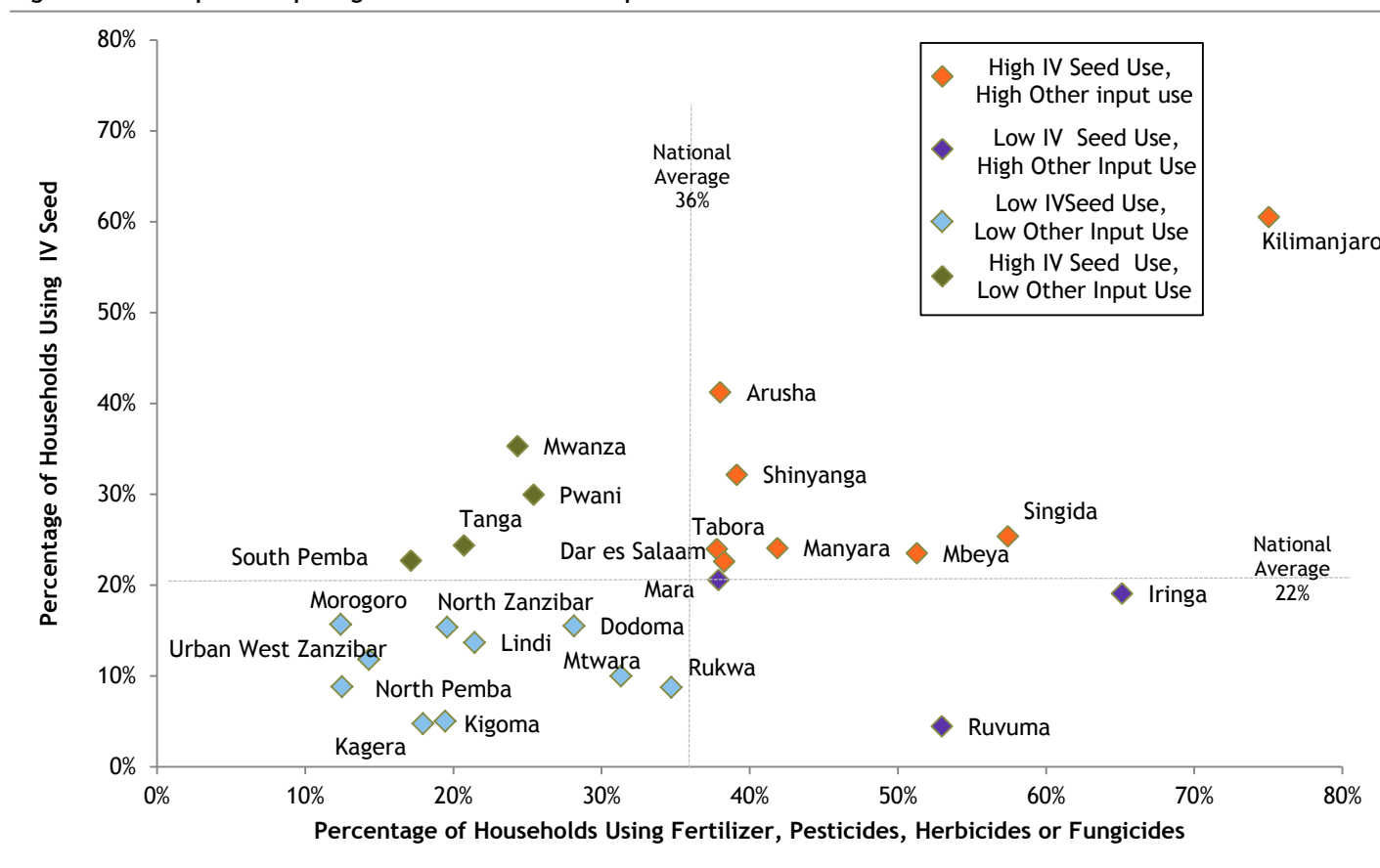
Figure 1: **Scatterplot Comparing IV Seed Use to Other Input Use**

2 Correlation coefficient = .43 with a significance of P<.001
3 One region (South Zanzibar) omitted due to insufficient observations to report

◆ **High IV seed use and low other input use:** Four out of twenty-five regions had higher than average IV seed use, but lower than average other input use rates.

◆ **High IV seed and other input use:** Eight regions had above average household use rates for IV seed and other inputs. Three out of four regions in the Northern Zone (Arusha, Kilimanjaro, and Manyara) and two out of three in the Western Zone (Tabora and Shinyanga) fell into this category.

Figure 1 suggests a relationship between higher regional use of IV seed and higher use of the other inputs including fertilizer, pesticide, herbicide, and fungicide. Only Ruvuma in the Southern Zone fell outside this trend, with high input use but very low IV seed use. The data show a statistically significant, positive correlation between improved seed use, and the use of all other inputs at the household level.[4]

Input and IV Seed Use Was Generally Highest for Maize

Maize was by far the most commonly grown crop in Tanzania giving it relatively more weight in the analysis. Maize plots were more likely to be planted with IV seed or have fertilizer applied than plots of any other priority crop.[5]

IV seeds were most commonly used for maize, planted in just over 15% of plots. All other priority crops were rarely planted with IV seed, with over 94% of plots planted with traditional seed in the 2008 long rainy season (*Figure 2*).

Figure 2: **IV Seed use by Crop in the Long Rainy Season**
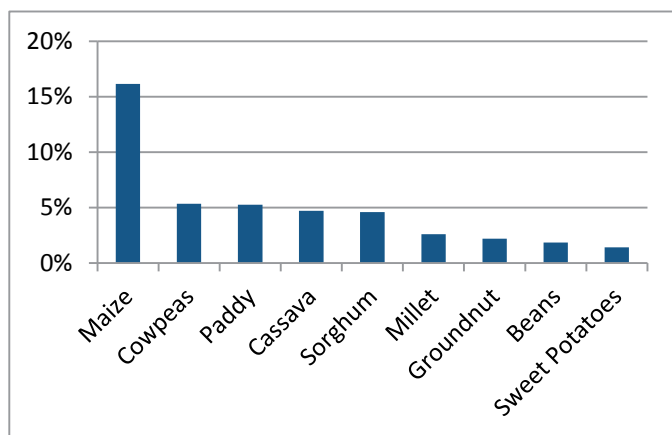
Of the most commonly grown crops, maize plots were most likely to be treated with some kind of input in the long rainy season, while cassava plots rarely received any inputs, with the exception of organic fertilizer *(Figure 3)*.[6] Pesticides,

herbicides, and fungicides were almost never used on cassava plots, but 11% of paddy plots and 11% of maize plots were treated with at least one of these inputs.

Figure 3: **Input use by Crop Type in the Long rainy Season**
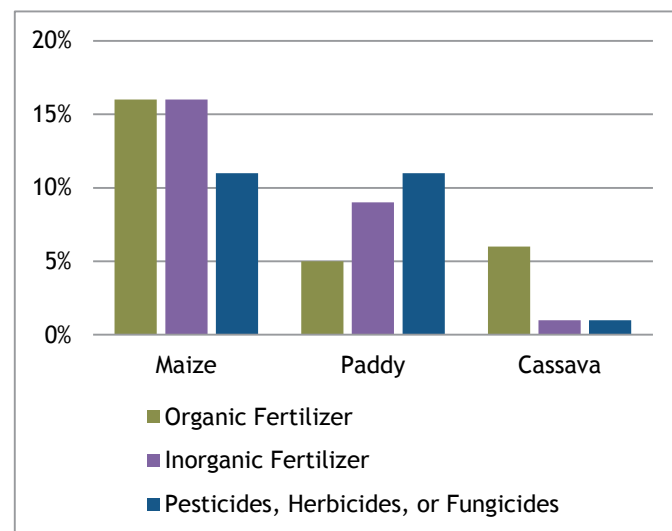
Average Maize Yields Varied Widely Based on Different Seed/Fertilizer Combinations

Maize plots on which farmers used IV seed and inorganic fertilizer had the highest average yields, before controlling for other factors.[7]

Figure 4 compares the plot-level TZNPS mean long rainy season maize yields based on IV seed and fertilizer use.[8] Plots that were planted with traditional seeds with no fertilizer yielded less maize than the national average, as did plots planted with improved maize seeds that used organic fertilizer. However, the differences were not statistically significant. Plots planted with traditional seeds with fertilizer (either organic or inorganic)

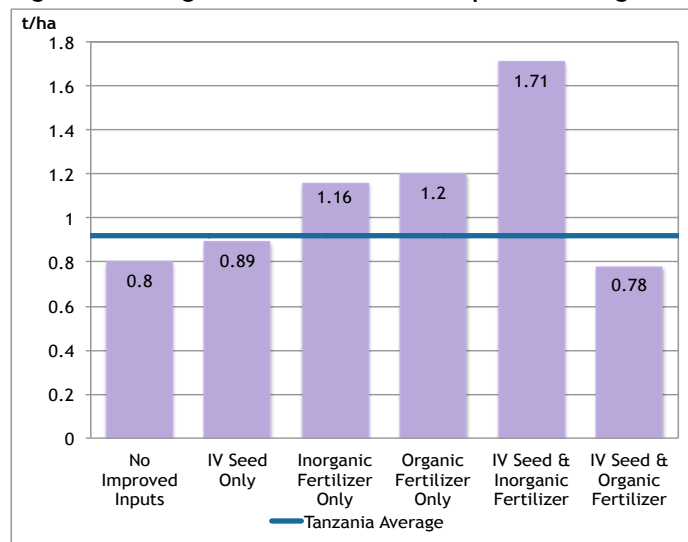*Figure 4:* **Average Maize Plot Yields for Input Use Categories**

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4 P<.001 for positive correlation between improved seed use and use of inorganic fertilizer, organic fertilizer, pesticides, herbicides or fungicides.
5 Priority crops include maize, paddy, cassava, sorghum, millet, beans, groundnuts, sweet potatoes, yams, cowpeas, and mangoes.
6 Most commonly grown crops refers to the "main crop" planted on a plot.

7 For further information on maize cultivation and yields in Tanzania, see EPAR Brief: Tanzania National Panel Survey LSMS-ISA:Maize
8 Yields were calculated using the area harvested, top 1% of observations were excluded from analysis

had higher yields than the national average. The highest maize yields were achieved on plots planted with improved seeds that applied inorganic fertilizer; however, the sample size was small with only 55 plots reporting this combination of inputs.
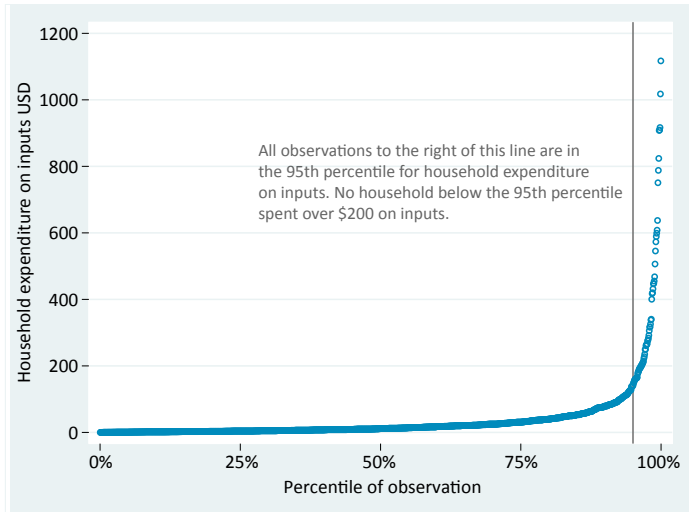
Three Percent of Farmers Account for Almost 50% of Total Expenditure on Inputs, With the Majority of Spending Going Towards Inorganic Fertilizer

The majority of farmers spent little on inputs[9] in the long and short rainy seasons, even when expenditure on traditional seeds was included. Of the 66% of farmers that purchased at least one input the median expenditure was under USD$11 for both growing seasons. The only input purchased by more than 20% of farmers was traditional seed (49%).

Figure 5 shows the distribution of expenditure on inputs for the households that purchased inputs. A small number of households accounted for a large proportion of total expenditure. There was a substantial gap in expenditure between the 50th percentile ($10.43) and the 95th percentile ($127.63). Households in the 95th percentile represented 3% of all farming households but accounted for 49% of total expenditure on inputs. These 95th percentile households were more likely grow tobacco and sunflowers, suggesting that input use may be more common for cash crops. These households were also more likely to use all types of agricultural inputs, suggesting that cost may be an important constraint to wider household input use, especially for inorganic fertilizer, used by 87% of households in the top 3% and only 10% of households in the bottom 97%. *Figure 6* compares household and farm characteristics for this small group of high-spending farmers.

Average landholding size was generally larger for households

Figure 5: Distribution of Household Expenditures on Inputs

All observations to the right of this line are in the 95th percentile for household expenditure on inputs. No household below the 95th percentile spent over $200 on inputs.

in the 95th percentile of input expenditure (*Figure 6*). About half of farming households in the 95th percentile for total expenditure were also in the 95th percentile for input expenditure per hectare. While total expenditure for some farmers may have been driven in part by landholding size (because larger farms can require more inputs), the relationship between landholding and input expenditure was not constant. Average landholding for farmers in the 95th percentile was about two times larger than for other households, while expenditure on inputs per hectare for this same group was ten times higher. The disparity between overall and per hectare expenditure indicates that input use does not rise proportionately with land size, suggesting that some smaller farms use inputs more intensively.

Figure 6: Snapshot of the Households Spending in the 95th Percentile on Inputs

Snapshot of the 95th Percentile

Breakdown of 95th percentile households by zone

Zone	Proportion
SouthernHighlands	38%
Northern	23%
Western	21%
Central	13%
Southern	6%
Eastern	0%
Lake	0%
Zanzibar	0%

Breakdown of 95th percentile household heads by gender

Gender of hh head	Proportion
Male	87%
Female	13%

Characteristics of household and household head

Household is:	Mean plotsize	Mean age	Mean education level
In 95th percentile	3.9	41.7	6.7
Not in 95th percentile	2.2	46.8	5.3

Top five crops for those in the 95th percentile by proportion of households that grew them

Crop	In the 95th Percentile	Not in the 95th percentile
Maize	96%	89%
Beans	50%	39%
Tobacco	34%	1%
Groundnut	21%	25%
Sunflower	19%	10%

Top five crops for those not in the 95th percentile by proportion of households that grew them

Crop	In the 95th percentile	Not in the 95th percentile
Maize	89%	96%
Beans	39%	50%
Cassava	34%	19%
Groundnut	25%	21%
Paddy	20%	9%

9 Inputs in the "Input Value and Purchasing" section refer to: improved seeds; traditional seeds; inorganic fertilizer; organic fertilizer; and pesticides, herbicides, or fungicides

The majority of money spent on inputs by Tanzanian farmers went to inorganic fertilizer, which accounted for 59% of the total value of inputs purchased. However, only 13% of farmers reported using inorganic fertilizer making it the least used of any input. Despite its high rate of usage, traditional seed accounted for only 13% of all money spent by farmers on inputs.

While 96% of households used traditional seeds, only 49% purchased them, suggesting that some seeds were saved and others were obtained through alternative means. The median household expenditure on inputs (for farmers who purchased inputs) was $10.43. *Figure 8* shows that farmers across zones purchased at least one input at roughly the same rate with the exception of Zanzibar. However, median annual expenditure on inputs differed substantially across zones. Three of the four zones with the highest median expenditure also had the highest proportion of households using inorganic fertilizer. The exception was the Western Zone where inorganic fertilizer use was lower than the national average but expenditure on other inputs, especially traditional seeds, was high.

Figure 7: Proportion of Households that used Input Compared to the Proportion of Total Expenditure on Inputs
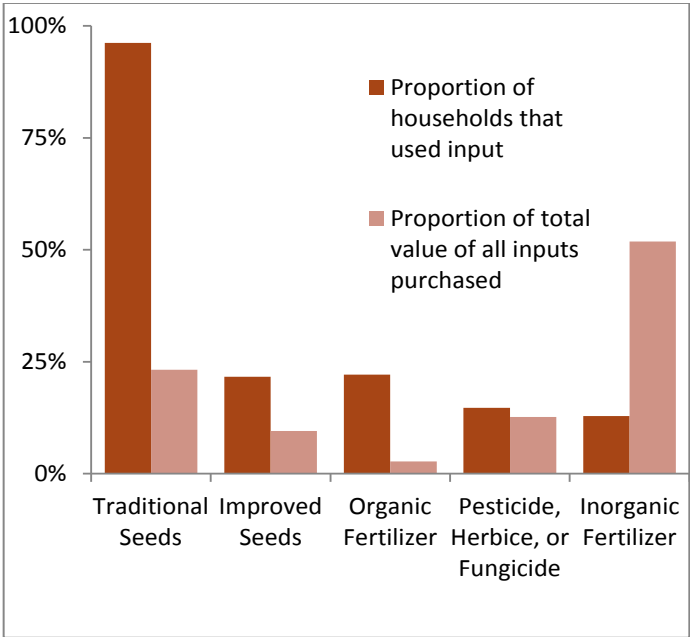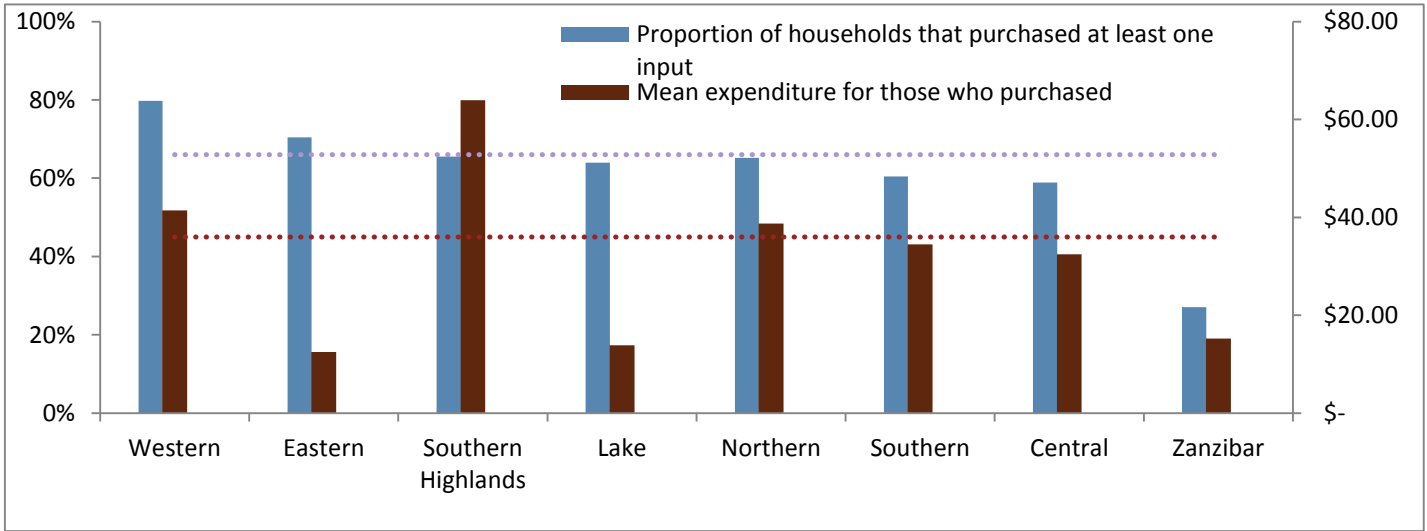

Figure 8: Proportion of Households Purchasing (Including Traditional Seeds) and Median Expenditure (USD) for Households that Purchased at Least one Input by Zone

Extension Advice, Education Level, and Expenditure on Hired Labor Were All Positively Correlated with Every Category of Input Use

Tables 2 and 3 show the factors associated with input use before controlling for other factors. Blue indicates a positive association, red indicates a negative association. For continuous variables, such as education of household head, the values represent the estimated increase in the probability of input use given a one unit increase in the variable. Thus one additional year of education attained by a household head increased the estimated probability that the household used inorganic fertilizer by 1.5 percentage points. For binary variables, such as advice from an extension officer, the value represents the change in estimated probability of input use

given that the condition is met. For example, receiving advice from an extension officer increased the probability that a household used inorganic fertilizer by an estimated 10.5 percentage points.

Table 2: **Factors Significantly Associated with Input Use**

	Use of PHF[1]	Use of inorganic fertilizer	Use of IV seed
Advice from extension officer	12.8%/***	10.5%/***	15.9%/***
Education of household head (yrs)	1.5%/***	1.5%/***	1.7%/***
Amount spent on hired labor(USD)	0.1%/***	0.03%/***	0.04%/***
Household landholding size(acres)	0.3%/***	.	.
Farmers' cooperative present	.	.	
Age of household head	-0.1%/**	.	.
Female household head	-6.6%***	.	-7.3%***

*p=.1, **p=.05, ***p<.01

Tables 2 and 3 present a first cut at understanding variation in input use, but these results demonstrate association, not causal relationships, and do not control for the influence of other factors.[10]

Receiving advice from an extension officer, the education level of household head, and annual expenditure on hired labor were positively associated with all categories of input use. Female-headed households were less likely to use each type of input with the exception of inorganic fertilizer for which the difference was not significant. The presence of a farmer's co-op in the community did not affect input use.

Strategic Implications and Outstanding Questions

Maize was the most commonly grown crop in Tanzania, cultivated by roughly 83% of households during the survey period. While maize plots were more likely to be planted with improved variety seeds or have fertilizer applied than all other priority crops, no individual input was applied to more than 15% of maize plots during the long rainy season. The large proportion of maize plots that did not have inputs applied, coupled with the ubiquity of maize cultivation implies that interventions directed at maize farmers might have the widest potential for increasing farm yields. However, data were insufficient to understand the net benefits of increased input use on maize plots.

During the long rainy season, maize plots treated with the seed/fertilizer combination of IV seed and inorganic fertilizer generated the highest maize yields. The concurrent use of these two inputs may be more effective than other seed/fertilizer input use combinations and have high potential in the "breadbasket" areas of Tanzania, where inorganic fertilizer use was relatively high but improved maize seed use was relatively low. However, yield analysis by zone was based on a small sample size and does not control for other factors.

Expenditure on inputs was concentrated among a small number

10 These effects were estimated using bivariate logit models where input use was the dependent variable and the household characteristic was the explanatory variable

Table 3: Zones Significantly Correlated with Input Use

	Use of PHF	Use of inorganic fertilizer	Use of IV seed
Northern	7.3%**	.	17.1%***
Southern Highlands	7.4%**	16.2%***	.
Southern	.1%*	.	-17.7%***
Central	-14.8%*	.	.
Western	.	-8.3%**	.
Eastern	.	-11.3%*	.
Lake	-11.5%**	-30.7%***	.
Zanzibar	-17.%***	-5.9%*	-9.3%**

*p=.1, **p=.05, ***p<=.01

of agricultural households, with 3% of farmers accounting for almost half of all expenditure, suggesting that economic constraints – particularly cash and credit constraints - might play an important role in household input use. Cost may be particularly important for inorganic fertilizer, which showed the greatest disparity in use between high and low spenders. Additional income or consumption measures beyond what is available in the 2008 TZNPS might help clarify the extent to which economic constraints affect input use among Tanzanian farmers.

Bivariate analysis of the TZNPS data indicates that a variety of factors may influence input use. At the national level, advice from an agricultural extension officer, education level of household head, and amount spent on hired labor were positively correlated with all input use categories, before controlling for other factors. Input use also varied by region, implying that there are different regional constraints to input use. However, regional input patterns were not consistent across input use types, indicating that factors affecting input use also varied based on the specific input. Efforts to increase input use should take into account the likely heterogeneity of constraints across region and input use category. Multivariate analysis might help to clarify what underlying factors are driving input use and how they differ across regions and input types.

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