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Tanzania National Panel Survey
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PADDY

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Tanzania National Panel Survey

LSMS-ISA: Paddy

Paddy Cultivation Varied Significantly Across Tanzania

Paddy was the sixth most commonly cultivated priority crop.[1] Nationally, paddy was cultivated by 17% of farming households, with male- and female-headed households cultivating paddy at a similar rate.[2] Cultivation rates varied widely across zones, ranging from 51% of households in Zanzibar to only 5% in the Northern Zone (see *Figure 1*). Perhaps more than other crops, the location of paddy cultivation did not correspond to regional or zonal boundaries, since rice systems tend to be confined to river valleys and alluvial plains.[3] Most paddy cultivation took place during the long rains, as regions in Zanzibar and the southeastern part of the country where paddy is frequently cultivated do not have a short rainy season and few plots were irrigated. Additionally, mean plot sizes ranged across the country with Western Zone having the largest (1.5 hectares, with a median of 0.81 hectares) and Zanzibar the smallest (0.26 hectares, with a median of 0.2 hectares).

Paddy was a High Value Crop

Paddy received one of the highest per kilogram prices among priority crops in the long rainy season according to prices reported by those survey respondents who sold crops. *Figure 2* shows that the mean and median value of paddy sold at the household level was appreciably higher than the value of any other priority crop.

1 Priority crops include maize, paddy, cassava, sorghum, millet, beans, groundnuts, sweet potatoes, yams, cowpeas, and mangoes.
2 For more information about gender in agricultural households in Tanzania, see EPAR Brief #190.
3 Ministry of Agriculture of Tanzania, http://www.tanzania.go.tz/agriculture.html

KEY FINDINGS

- Paddy was cultivated by 17% of agricultural households and production was clustered in relatively few areas.
- Paddy had the highest average household sales value of all priority crops among those households selling crops.
- Paddy plots achieved the second highest land productivity and the highest labor productivity among priority crops.
- Paddy yields on plots varied significantly, with the 90th percentile producing 206% more than the median plot.
- Over half of paddy plots suffered pre-harvest losses and paddy had the highest rate of post-harvest loss across all crops.
- Only 5% of paddy plots were planted using improved variety (IV) seeds and other input use was also low.

***Figure 1*: Percentage of Agricultural Households Cultivating Paddy in the Long Rainy Season and/or Short Rainy Season**

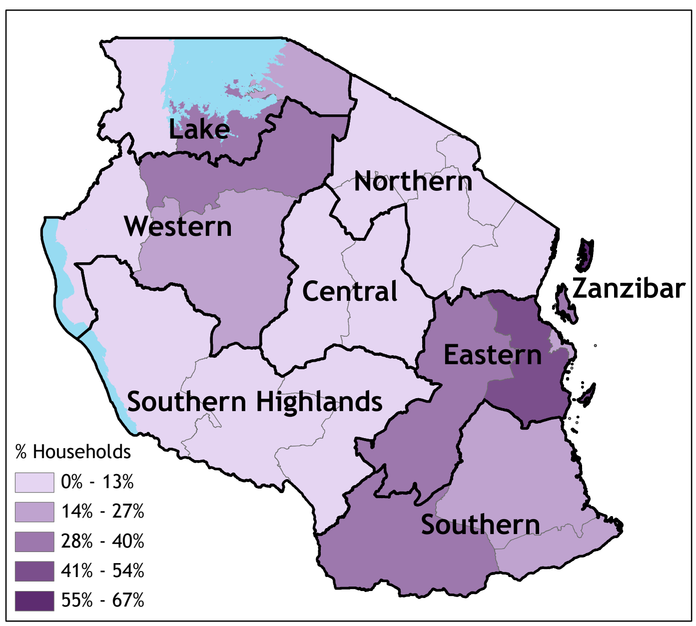
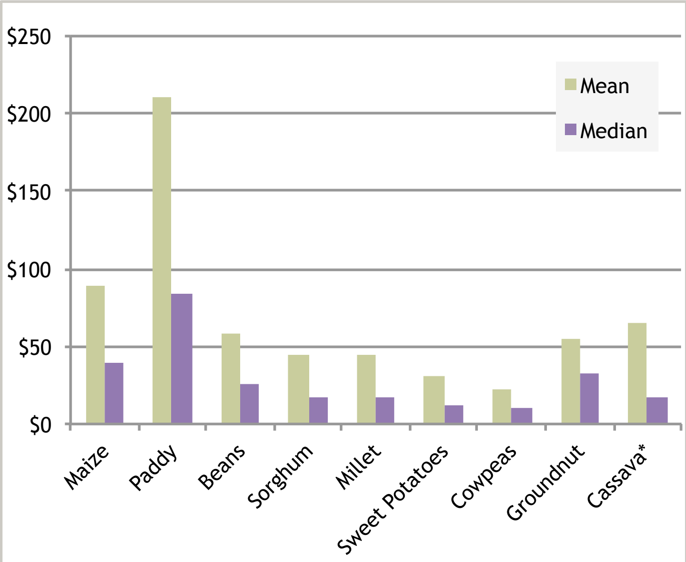


Figure 2: **Mean and Median Value of Crop Sold in the Long Rainy Season ($USD/kg)**



**Based on permanent crop observations instead of long rainy season observations.*

Nationally, paddy accounted for the second largest share of crop sale value, behind maize.[4] Paddy sales in Tanzania generated roughly two and half times as much revenue in the long rainy season as in the short rainy season. Although the absolute value of these sales was lower during the short rainy season, paddy's relative contribution increased from 15% of total crop value in the long rainy season to 28% in the short rainy season.

As expected, households selling paddy had significantly higher yields than those not selling (1.89 t/ha compared to 1.09 t/ha).[5] Also, households with high value from sales (the top 20th percentile) had average yields over 60% higher than households in the bottom 80th percentile.[6]

Households growing paddy were the most likely (52%) to sell their crop among all priority crops. This proportion varied widely by zone, ranging from 0% selling paddy in Zanzibar,[7] the zone with the lowest median yield, to 88% of households selling in the Southern Highlands, the zone with the highest median yield.

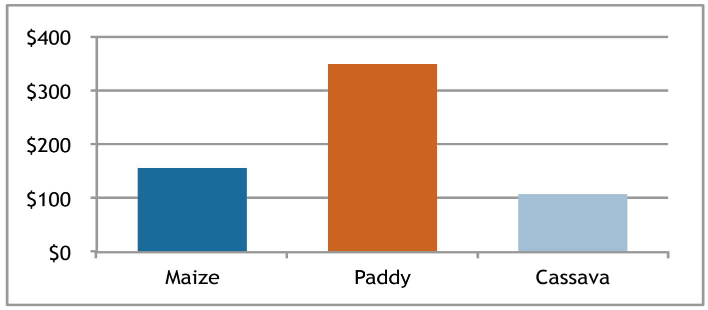
The proportion of households selling paddy was similar across male- and female-headed households, as was the average price received per kilogram. However, on average, male-headed households sold more than double the paddy (684 kilograms per household versus 296 kilograms for female-headed households)[8] and earned double the value of sales during the long rainy season ($239 to $112).[9]

4 Although paddy has the highest average value, maize accounted for the largest share of sale value because it had a larger volume of sales nationally.
5 Statistically significant at p<.0008.
6 2.73 t/ha to 1.67 t/ha, statistically significant at p<.0015.
7 This estimated proportion is based on 130 observations.
8 Statistically significant at p<0.0045.
9 Statistically significant at p<0.0343.

Paddy Productivity was the Highest Among all Priority Crops

Plots with paddy as the main crop grown had the highest mean labor productivity ($5.56/work day) relative to other priority crops; these plots also had the second highest mean land productivity ($349/ha) (see *Figure 3*).[10] These measures increased substantially for farmers cultivating in the short rainy season ($11.94/work day and $486/ha respectively), although these estimates are based on observations from only 43 plots.

Figure 3: **Mean Land Productivity of Maize, Paddy, and Cassava in the Long Rainy Season**



Paddy Yields were Below FAO Estimates and Highly Variable

Estimated mean country level paddy yields for the long rainy season (1.29 t/ha) fall well below FAO's yield estimates (2.03 t/ha), and the median yield was even lower (see *Table 1*). Paddy yield in the short rainy season was much higher, with a mean of 3.20 t/ha. However, there were significantly fewer short rainy season observations (47 plots), and these were concentrated in the Northern and Lake zones, suggesting that geography rather than season may be the driving factor.

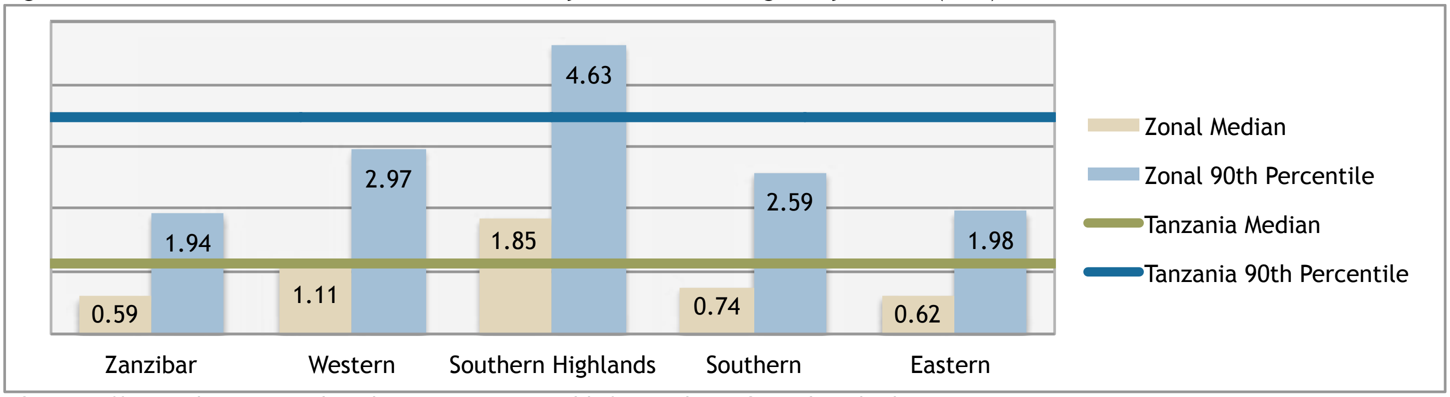
Paddy yield estimates reveal one of the largest yield differentials of any priority crop, with the 90th percentile harvesting over 206% more tons per hectare than the median plot in the long rainy season (3.46 t/ha versus 1.13 t/ha). The variation in yield across zones is similarly large, with the Southern Highlands yielding 300% more than Zanzibar, despite the higher rate of cultivation in Zanzibar (see *Figure 4*). Despite these zonal variations, male- and female-headed households cultivating paddy achieved similar yields during the long rainy season.

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

	Long Rainy Season	Short Rainy Season
Number of Plot Yield Observations	492	47
Median Yields (t/ha)	1.13	1.93
Proportion of Households that Sold Paddy	52%	49%
Zone with Highest Proportion of Households Cultivating	Zanzibar	Lake

10 The value of long and short rainy season productivity was calculated by summing the estimated value of harvest for each crop on a given plot. If the respondent had not finished the harvest, the value of the crop not yet harvested was projected by assigning the same value/kilogram to the amount left to be harvested.

Figure 4: **Median and 90th Percentile Plot Yields by Zone in the Long Rainy Season (t/ha)**



NOTE: Insufficient observations (less than 30) to report yields for Northern, Central, and Lake zones.

High Producing Paddy Plots were Smaller, Closer to the Market, and Used Inputs at a Higher Rate

High producing plots (defined as plots in the top ten percent)[11] had different characteristics than plots below the 90th percentile (see *Table 2*). High producing plots were significantly smaller,[12] closer to market,[13] and were 20% less likely to be cultivated on loam soil. High producing plots were also 4% more likely on average to use inorganic fertilizer or at least one pesticide, herbicide, or fungicide, but this difference was not significant. Households with high producing plots owned livestock at a significantly higher rate[14] and had household heads with one more year of education on average.[15]

Table 2: **Comparison of High Producers and Non-High Producers***

	Non-High Producers	High Producers
Plot Size	0.89 ha	0.53 ha
Distance to Market	8.2 km	5.3 km
Proportion of Plots with Loam Soil	54%	34%
Proportion of Inorganic Fertilizer Usage	9%	14%
Proportion of Pesticide/ Herbicide/Fungicide Usage	11%	14%
Proportion of Households Owning Livestock	67%	85%
Average Education of Household Head	5.3 years	6.4 years

**Non-high producers are defined as the bottom 90% of plots by yield.*

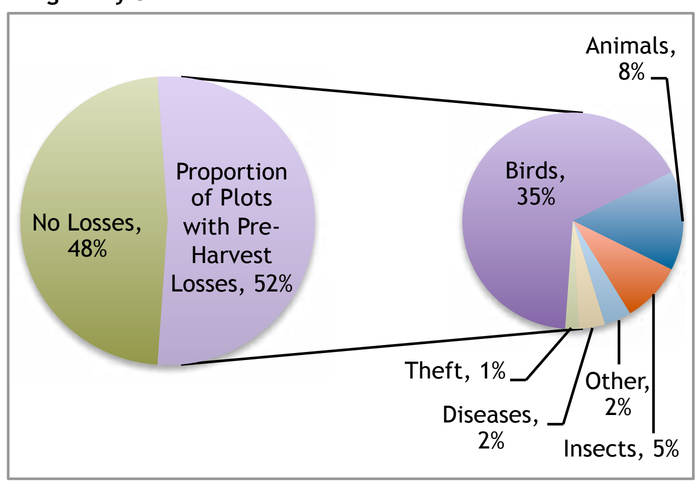
The data additionally showed that plots that did not intercrop produced higher yields (1.73 t/ha to 0.98 t/ha). However, these yields do not account for lower plant density (not reported in the TZNPS) or the yields of the intercropped crop. Also, households owning livestock reported 70% higher paddy yields than households without livestock.

11 36 plots were identified as high producing (in the top 10th percentile of yields).
12 Statistically significant at $p<0.0350$.
13 Statistically significant at $p<0.0020$.
14 Statistically significant at $p<.0012$.
15 Statistically significant at $p<0.0338$.

Pre-Harvest and Post-Harvest Losses Affected Roughly Half of Paddy Plots

Over half of paddy plots suffered pre-harvest losses in both the long and short rainy seasons (52% and 53% of plots respectively). In both seasons, millet was the only priority crop with a higher level of reported loss. The average rate of pre-harvest loss across all crops was 36% in the long rainy season. Paddy plots in Zanzibar were affected at a much higher rate than the national average (72%), while those in the Western Zone were less frequently affected (22%). In the long rainy season, birds were the most frequently cited reason for pre-harvest loss (see *Figure 5*).

Figure 5: **Reasons for Pre-Harvest Losses of Paddy in the Long Rainy Season**

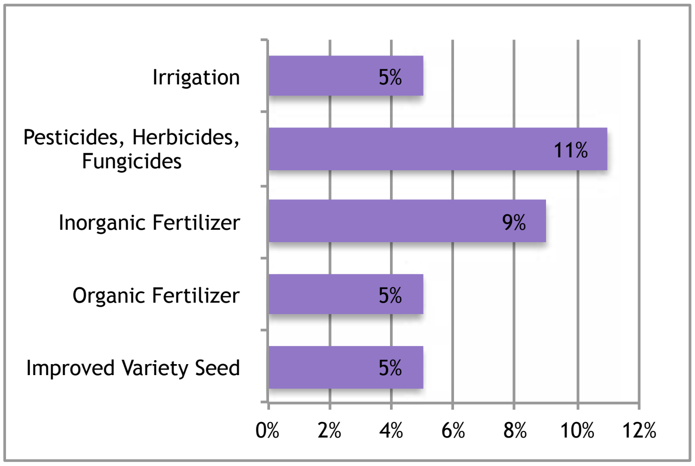


Households growing paddy had the highest frequency of post-harvest losses during the long rainy season (15%) and second highest during the short rainy season (22%) of all priority crops. The most commonly cited cause of losses during the long rainy season was rodents and pests (85%). Zanzibar had the highest proportion of households affected by post-harvest losses (28%).

Input Use and Irrigation were Low on Paddy Plots

Paddy farmers overall reported low rates of input use and irrigation (see *Figure 6*).[16] Eleven percent of paddy plots were treated with at least one pesticide, herbicide, or fungicide during the long rainy season. Reported use varied widely by zone, ranging from 3% in the Western Zone to 37% in the Southern Highlands. Mean plot yields were significantly higher on plots that used at least one of these inputs (see *Table 3*).[17]

***Figure 6*: Proportion of Paddy Plots using Inputs and Irrigation in the Long Rainy Season**



During the long rainy season, 5% of plots were treated with organic fertilizer and 9% were treated with inorganic fertilizer. Rates of inorganic fertilizer use varied from 0% in the Western Zone to 19% in the Southern Zone.[18] Mean plot yields appear higher on plots that used inorganic fertilizer (see *Table 3*), but this difference was not statistically significant and the number of observations is low.[19]

***Table 3*: Mean Plot Yields by Input Use in the Long Rainy Season**

	Mean Yield for Users (t/ha)	Mean Yield for Non-users (t/ha)
Pesticide, herbicide, or fungicide	2.21	1.49
Inorganic fertilizer	1.92	1.53

NOTE: The combined use of inorganic fertilizer and pesticides, herbicides, or fungicides occurred rarely (8 observations), thus yield differentials cannot be calculated.

16 For more information about input adoption in Tanzania, see EPAR Brief #179.
17 Statistically significant at p<0.0232, based on 41 observations. Median yields were lower for both users and non-users, at 1.04 t/ha and 1.76 t/ha respectively.
18 This estimated proportion is based on 46 observations.
19 During the long rainy season, 23 plots out of 491 reported using organic fertilizer and 58 plots out of 491 reported using inorganic fertilizer. Median plot yields were lower than mean yields for both inorganic fertilizer users and non-users, at 1.73 t/ha and 1.11 t/ha, respectively.

Improved variety (IV) seeds were used on 5% of plots during the long rainy season and only 5% of paddy plots were irrigated, which was higher than the overall average of 3% for all crops, but this difference was not significant. Irrigation was most common in the Southern Highlands (10% of plots). Yields for plots that used IV seeds or irrigation could not be calculated due to the low number of observations (26 plots and 19 plots respectively).

Strategic Implications and Outstanding Questions

Paddy plots had higher productivity and yielded higher sales values for households that sold the crop than most other priority crops, suggesting that paddy may have significant income-generating potential for households in paddy-growing areas. Paddy was cultivated by 17% of agricultural households, but cultivation was concentrated in relatively few areas, suggesting that interventions may need to be targeted geographically. The potential for expanding paddy cultivation is difficult to assess with existing data, as expansion would likely depend on the availability of appropriate land.

The large yield differential between the median and the 90th percentile plot suggests the potential for increasing yields. Paddy yields were highly variable by geographic location. In regions like Zanzibar, where rice is a staple food, cultivation rates are high but yields are relatively low, so increasing yields could potentially improve household welfare. High rates of reported pre- and post-harvest losses suggest that strategies to reduce bird damage pre-harvest and to improve post-harvest storage could improve yields and farm profitability throughout the country.

Input use on paddy plots was low overall and varied by geography. Input use was only marginally higher on high producing plots, suggesting that cultivation practices may also play an important role in explaining yield outcomes. However, the information is too limited to draw strong conclusions at this point. TZNPS data demonstrate a statistically significant relationship between pesticide, herbicide or fungicide use and yields; the number of observations may be too limited to detect significant relationships for other paddy inputs. A better understanding of paddy cultivation and potential in Tanzania may require more intensive surveying in paddy-growing areas. Understanding the potential for yield improvement and the expansion of paddy cultivation will also require additional information about the land and soil conditions of smallholder farmers.

The highest producing households were more likely to own livestock, but what drives this relationship is unclear. Livestock ownership may be a proxy for household wealth, or there may be important synergies between livestock ownership and increased paddy yields such as access to organic fertilizers. Paddy yields were also higher in the short rainy season than in the long, unlike most other crops. This could be the result of greater specialization in the short rains, agro-ecological differences in the areas that have a short rainy season, or a number of other factors, but this relationship may warrant further investigation.

Although paddy was the most commonly sold priority crop, the likelihood that a household sold paddy varied. Location appeared to play a key role. While over 50% of agricultural households in Zanzibar cultivated paddy, there were no observations of households that sold paddy, likely because rice is a staple food in Zanzibar. In the Southern Highlands, 88% of paddy-cultivating households sold some of their yields, suggesting that paddy may function more as a cash crop in those areas. Interventions that focus on market access may be more appropriate in areas where sales are more prevalent and interventions focusing on increasing yields may be a preliminary step in areas such as Zanzibar, which also had some of the lowest yields in the country.

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.