

Are rice markets efficient in Mozambique to help alleviate food insecurity?

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Motivation

Despite Mozambique's rapid economic growth, 25 percent of the country remains chronically food insecure. Rice is the third most important source of calories in Mozambique behind maize and cassava. Domestic rice consumption has been steadily increasing over the past 30 years from 86 MMT in 1990 to 868 MMT most recently in 2019, an over 900% increase in consumption.

In markets, rice is commonly sold from an open bag. From the bag, it is visually difficult to differentiate between different levels of quality attributes. For example, differentiating between 10% broken and 15% broken would be difficult yet we would expect the market to price the two different levels differently. Weaknesses in the grades and standards system in Mozambique, which are recognized even by the Mozambican government, undermine the transparency of the rice market. This, combined with the open-bag nature of the market, can make it difficult for consumers to assess rice quality.

If rice price does not reflect its quality, then irregularities may lead to welfare losses. Importantly, if rice is not being priced based on quality there is a chance that the poor are being priced out of the market based on inflated prices.



Example of a market where rice is sold from an open bag.

Study Objectives

1. Access the efficiency of the rice market by estimating the impact of selected rice quality attributes on the price of rice. The visual quality attributes driving price would indicate a functioning market. Whereas, quality attributes being highly insignificant in models would indicate the rice is not priced accurately for its quality.
2. If the rice price is a function of quality attributes, we can determine which quality attributes are the drivers of price. By understanding pricing mechanisms rice imports, domestic rice production, and rice variety development can be better tailored to consumer preferences.

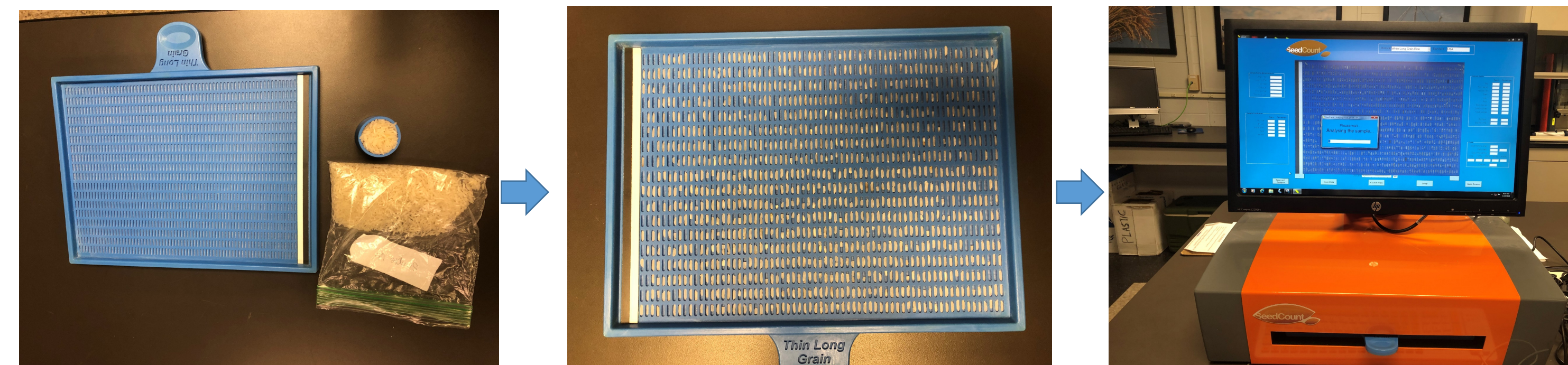
Data

Data Collection

112 long grain non-fragrant rice samples were collected from 11 open-air markets across Nampula, Mozambique in June of 2019. Nampula is the third largest city in Mozambique. Each of the samples was purchased by the same person speaking either Portuguese or Makua (a local tribal language). Price per kg of rice was posted by seller, so there was no negotiation.

Rice Analysis

Rice was analyzed in the Rice Processing Lab at the University of Arkansas using the SeedCount Image Analysis System. The system uses a random 20 gram sample to create a sub-sample to process a 500- kernel sample and employed a flatbed scanner to create a digital image of each individual rice kernel. Kernel-by-kernel data was taken for each of the 500-kernel sample and then aggregated for an average score for a given sample. Thus, from the Seed Count results we could quantify selected search attributes.



Variables

Collected at Purchase	Quality Variables
Price per unit in domestic currency	Length (mm)
Market	Width (mm)
Imported/Domestic	Broken (%)
Parboiled	Chalkiness

All the samples were imported and none of the samples were parboiled so those those binary variables were not included. We considered two measures of chalkiness. Percent chalky measures the percent of kernels that are at least 50% chalky. Chalk impact measures the area of the sample that is chalky. We used chalk impact in our preferred model because of the wider range of values; however, regardless of which measure of chalkiness was used the results were similar. Fixed effects for the market were tested, but they decreased degrees of freedom without provided new insights.

Methodology

Multiple regression analysis was used to estimate the impact of each quality attribute on the observed price. We opted to use a log-log model to compare elasticities for each quality attribute.

Preferred model:

$$\log(\text{Price}) = \beta_0 + \beta_1 \log(\text{Broken}) + \beta_2 \log(\text{Length}) + \beta_3 \log(\text{Width}) + \beta_4 \log(\text{Chalk Impact}) + \varepsilon$$

Results

Table 1 Summary Statistics

	Mozambique
Price (USD) ^a	
Min	0.49
Mean	0.67
Max	0.98
Length (mm)	
Min	5.77
Mean	7.01
Max	7.6
Width (mm)	
Min	2.19
Mean	2.32
Max	2.6
Broken (%)	
Min	1.5
Mean	7.3
Max	22.5
Chalk Impact (0-100)	
Min	0.18
Mean	3.5
Max	27.83
Observations	112
2018 Per Capita Rice Consumption (kg)	31.5 ^b

^aExchange rate as of June 2, 2020.
^bDurand and Chavez (2020).

Table 2 Preferred Model

Variable	Mozambique
Constant	2.183* [1.158]
Broken	-0.094*** [0.034]
Length	-0.034 [0.452]
Width	2.339*** [0.681]
Chalk	-0.065** [0.026]
R ²	0.416
Observations	112

***, **, * denotes P<0.01, P<0.05 and P<0.1, respectively.
[] denote, robust standard errors.

Conclusions

1. In Mozambique, a 1% increase in brokens would reduce price by 0.094% (P<0.01). To put this in perspective, the difference between the maximum and minimum percentage of broken rice in the Mozambique rice samples was 21%. This would suggest that there would be a price difference of 1.95%, a small difference given any definition.
2. In Mozambique chalk was found to negatively affect rice price, with a 1% increase in chalk resulting in a 0.065 percent decrease in price (P<0.05). The difference between the chalkiest average sample and the least in Mozambique was 27.65%, which would result in a price difference of 1.79%. It appears that chalk, while significant, is either not being priced correctly or is simply not a large factor in rice price in Mozambique.
3. In Mozambique width was found to affect price with a 1% increase in width leading to a 2.4% in price (P<0.01) but price was not found to be a function of length. The difference between the largest average width sample collected in Mozambique and the smallest average width sample was 18.72%. Using the estimated coefficient from Table 2 would result in a price difference of 43.79%, ceteris paribus.
4. Our results indicate either consumers do not value non-broken rice and are not willing-to-pay a premium (we find a premium but it's not a large factor), or the lack of standards and grading has led to a market failure. If more markets accept broken (or at least a higher percentage of broken) rice, then a possibility exists to increase food security.
5. From a food security perspective, future research should use non-hypothetical experiments to determine what, if any, thresholds consumers would value for broken rice in Mozambique, one of Africa's fastest growing countries.