Consumers’ Willingness-to-Pay for High Zinc and Low-Milled Rice in Bangladesh

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• Zinc deficiency is considered a severe public health issue in Bangladesh
  • Needed for proper physical, cognitive, and immune system development

• 30% of Bangladeshis are at risk of inadequate zinc intake
  • Most vulnerable: (1) Under 5, and (2) Women-of-child-bearing age (15-49)

http://apps.who.int/ghodata/
Zinc can most readily be attained through proper dietary diversity but most Bangladeshis cannot afford and/or do not have access to such a diet. Therefore, we look at two staple-crop interventions.

**Variety: Biofortified High Zinc Rice**
- Same agronomic and consumption traits as most popular varieties
- Currently 8 varieties delivered in 62/64 districts
- Contains 70% more zinc than non-biofortified rice, milled at the same levels.

**Processing: Low-Milled Rice**
- Traditional method (7.5% milling)
- More auto-rice mills popping up (15% milling)
- Zn typically contained in the endosperm of the plant but with par-boiling, it moves to outside
- Contains 200% more zinc than high-milled rice
Research Questions

(1) What are consumers’ acceptance and demand for low-milled and biofortified rice?

(2) Does sharing nutritional (zinc) information -- its importance, benefits, and availability in zinc biofortified and low-milled rice -- impact consumers’ acceptance and demand of these products?

(3) What determinants exist (if any) for biofortified and low-milled rice, beyond information?
Methodology – Study Area & Data

• 576 rice consumers were surveyed
  • Dinajpur, a rice-surplus producing district
  • Satkhira, a rice-deficit district

• Data collection
  • Timing: 4 sessions/day (12 individuals per session)
  • Location: Community center in nearest upazila

• Randomization of respondents:
  • Evenly split among info groups (n=192/group)
  • Within each session
  • No statistical differences in observables (balance)

• The WTP study followed a consumer sensory evaluation
• Data was collected in December 2018, March 2019. Data entry completed in July 2019.
Methodology – Study Design

• We conduct a between-subject WTP experiments using the Becker-DeGroot-Marschak (BDM) mechanism.

• Rice grain products:
  • (1) Biofortified, low-milled (BLM) used as the benchmark
  • (2) Non-biofortified, low-milled (NBLM)
  • (3) Non-biofortified, high-milled (NBHM)

• Groups:
  • (1) Control group with no information
  • (2) Zinc biofortified information (TG1)
  • (3) Low-milling benefits information (TG2)
Methodology – Empirical Framework

1. Compare Mean Differences in WTP bids (premiums/discounts)

2. Run OLS parsimonious regression and long regressions to determine significance of treatment effect size (product x info) and tests its robustness (Raw WTP bids)

\[
Bid_{ijt} = \alpha + \beta_1 P_j + \beta_2 T_t + \beta_3 (P_j \times T_t) + u_{it} \quad \text{(SR)}
\]

\[
Bid_{ijt} = \alpha + \beta_1 P_j + \beta_2 T_t + \beta_3 (P_j \times T_t) + \eta X_i + \gamma (T_t \times Y_i) + u_{it} \quad \text{(LR)}
\]

where $Bid_{ijt}$ is the WTP bid for consumer $i$ for product $j$ under treatment $t$, $P_j$ represents the rice product, $j = 0, 1, 2$, ($0$=NBLM, $1$=BLM, $2$ = NBHM), $T_t$ represents the information treatment, $t = 0, 1, 2$, ($0$=control, $1$=biofortified rice info, $2$ = low-milling info), $X_i$ represents a vector of respondent characteristics and experiment controls, $Y_i$ represents a vector of observables interacted with treatment variable, $u_{it}$ is the idiosyncratic error term.

3. Marginal WTP: determinants of premiums/discounts beyond information to help with initial implementation of nutritional awareness campaigns (OLS)

\[
PremBid_i = \alpha + \beta_1 T_t + \eta X_i + \gamma (T_t \times X_i) + u_i
\]
Results – Bid Mean Comparisons & TES Significance

Treatment Effect Size (Info x BLM):
• Short Regression: 1.55*** (0.36)
• Long Regression (includes control vars): 1.55*** (0.37)

Treatment Effect Size (Info x NBLM):
• Short Regression: 1.78*** (0.41)
• Long Regression (includes control vars): 1.78*** (0.42)

Statistical significance denoted as follows: * = 0.10 level, ** = 0.05 level, and *** = 0.01 level.
Results – Marginal WTP (BLM vs. NBLM)

- **No information**
  - Positive:
    - Female: 1.7*** (0.8)
    - Resides in Dinajpur district: 0.8** (0.3)
    - HH per-capita yearly rice consumption: 0.1** (0.1)
  - Negative:
    - No. of children in HH 5 years old or younger: -0.8*** (0.3)
    - Main occupation: farming: -1.3*** (0.4)

- **Information**
  - Positive: No. of children in HH 5 years old or younger: 1.1* (0.6)

*Statistical significance denoted as follows: * = 0.10 level, ** = 0.05 level, and *** = 0.01 level.*
Results – Marginal WTP (NBLM vs. NBHM)

• **No information**
  • Positive:
    • No. children under of 5 in HH: 0.7** (0.3)
  • Negative:
    • Age: -0.04* (0.02)
    • Years of formal education: -0.2*** (0.1)
    • HH purchases rice monthly/every 2 months: -1.0*** (0.3)

• **Information**
  • Positive: Years of formal education: 0.3*** (0.1)

Statistical significance denoted as follows: * = 0.10 level, ** = 0.05 level, and *** = 0.01 level.
Conclusions & Policy Implications

• Consumers respond to nutrition information when stating WTP for rice
  • Easier effort for biofortified rice vs. low-milled rice

• Recommendations for initial awareness campaign targeting for biofortified zinc rice:
  • Rice-surplus producing regions
  • Non-farm workers
  • Females
  • Families with children under five years of age.

• Recommendations for initial awareness campaign targeting for low-milled rice:
  • Individuals with higher education
  • Families with children under 5 years of age
  • Households that purchase rice more frequently than monthly
Future Research

• Evaluation a milling level of 11% (maybe a compromise for consumers)

• Evaluate what type/how information is shared
  • Who is giving the information
  • Positive versus negative information
  • Method of information sharing (video, radio, etc.)

• Conduct experiment in peri-urban and/or urban areas

• Recent push for rice fortification in Bangladesh, this study can serve as a benchmark
Thank you!


## Results – Treatment Effect Size (BFLM)

### Short Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>Est. coeff.</th>
<th>Robust Std. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (NBLM rice)</td>
<td>33.84***</td>
<td>0.3</td>
</tr>
<tr>
<td>Biofortified Rice Product (BLM)</td>
<td>0.39*</td>
<td>0.21</td>
</tr>
<tr>
<td>Received Biofortified Zinc Info</td>
<td>-0.30</td>
<td>0.42</td>
</tr>
<tr>
<td>Received Biofortified Zinc Info x BLM Rice Product</td>
<td>1.55***</td>
<td>0.36</td>
</tr>
<tr>
<td>R-Square</td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>Number of observations</td>
<td></td>
<td>768</td>
</tr>
<tr>
<td>Number of respondents</td>
<td></td>
<td>384</td>
</tr>
</tbody>
</table>

### Long Regression

1.55 *** (0.37)

Statistical significance denoted as follows: * = 0.10 level, ** = 0.05 level, and *** = 0.01 level.
### Results – Treatment Effect Size (NBLM)

#### Short Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>Est. coeff.</th>
<th>Robust Std. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant (NBHM rice)</td>
<td>39.36***</td>
<td>0.33</td>
</tr>
<tr>
<td>Non-Biofortified, Low-Milled Rice Product (NBLM)</td>
<td>-5.52***</td>
<td>0.23</td>
</tr>
<tr>
<td>Received Low-Milling Info</td>
<td>-1.57***</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Received Low-Milling Info x NBLM Rice Product</strong></td>
<td>1.78***</td>
<td>0.410</td>
</tr>
<tr>
<td>R-Square</td>
<td></td>
<td>0.21</td>
</tr>
<tr>
<td>Number of observations</td>
<td></td>
<td>768</td>
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#### Long Regression

1.78 *** (0.420)

Statistical significance denoted as follows: * = 0.10 level, ** = 0.05 level, and *** = 0.01 level.
Methodology – BDM Details

• BDM: 1 on 1 auction-like experiment (exchange of real money for real goods)

• **Steps:**
  1. Enumerator explains all steps of the BDM mechanism to respondent
  2. Practice round with cookies; Q&A
  3. Respondent listens to their selected information based on if in TG1 or TG2;
  4. Respondent observes the 3 bowls of 1kg rice products, provides their WTP bid
     1. Recall recent rice mkt prices
     2. Bid true WTP as only one rice product will be selected
  5. Respondent selects 1 out of 3 colored die (coordinated to lid color of each rice product)
     from an opaque bag as the “binding” product for bid/market comparison
  6. Respondent selects “market price” coin from opaque bag.
  7. If bid ≥ mkt price → respondent “wins” 1 kg of rice; money/rice exchanged at mkt price
## Respondent Demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Mean Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=192)</td>
<td>(N=192)</td>
<td>(N=192)</td>
<td>(p-value)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>94.8</td>
<td>92.7</td>
<td>92.7</td>
<td>0.637</td>
</tr>
<tr>
<td>Household Head (%)</td>
<td>84.9</td>
<td>86.5</td>
<td>84.9</td>
<td>0.882</td>
</tr>
<tr>
<td>Age (years)</td>
<td>41.2 (12.7)</td>
<td>41.9 (13.3)</td>
<td>41.4 (13.3)</td>
<td>0.853</td>
</tr>
<tr>
<td>Years of formal education</td>
<td>5.1 (4.8)</td>
<td>5.1 (4.7)</td>
<td>5.3 (4.8)</td>
<td>0.870</td>
</tr>
<tr>
<td>Main occupation is farming (%)</td>
<td>52.6</td>
<td>51.6</td>
<td>52.6</td>
<td>0.973</td>
</tr>
<tr>
<td>Household size</td>
<td>4.8 (1.6)</td>
<td>4.7 (1.7)</td>
<td>4.8 (1.6)</td>
<td>0.934</td>
</tr>
<tr>
<td>No. of kids under 5 years old living in HH</td>
<td>0.4 (0.4)</td>
<td>0.4 (0.6)</td>
<td>0.4 (0.6)</td>
<td>0.585</td>
</tr>
<tr>
<td>No. of WOCBA living in HH</td>
<td>1.5 (0.8)</td>
<td>1.4 (0.7)</td>
<td>1.5 (0.8)</td>
<td>0.515</td>
</tr>
<tr>
<td>HH's per-capita yearly rice consumption (in 10kg)</td>
<td>15 (3.9)</td>
<td>15.3 (4.2)</td>
<td>15.2 (3.6)</td>
<td>0.747</td>
</tr>
<tr>
<td>Household purchases rice daily (%)</td>
<td>9.9</td>
<td>12.5</td>
<td>13</td>
<td>0.598</td>
</tr>
<tr>
<td>HH purchases rice once a month or less (%)</td>
<td>33.3</td>
<td>35.9</td>
<td>32.8</td>
<td>0.788</td>
</tr>
<tr>
<td>HH's per-capita monthly income (in BDT)</td>
<td>2120.7 (1642.1)</td>
<td>2053.9 (1484.5)</td>
<td>2070.1 (1590.8)</td>
<td>0.910</td>
</tr>
<tr>
<td>Aware of high zinc rice varieties (%)</td>
<td>8.33</td>
<td>9.9</td>
<td>13</td>
<td>0.310</td>
</tr>
</tbody>
</table>