Towards a Compendium of Methods and Metrics to Measure the Market Food Environment: a Conceptual Framework

Djeinam Toure, Mduduzi NN Mbuya, Bonnie McClafferty, Tom Reardon, David Tschirely, Lynnette M Neufeld.

This study was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of GAIN and do not necessarily reflect the views of USAID or the US government.
• The majority of the people purchase a sizeable share of their food in markets
• In east and southern Africa, 40% of food is purchased (Tschirley, 2015)
• This holds true in rural areas, and among the low income
Markets Matter for Nutrition

• The majority of the people and the world’s poor purchase most of their food in markets
  • In east and southern Africa, 40% of food is purchased (Tschirley, 2015)
  • This holds true in rural areas, and among the low income
• Markets in part shape people’s diets and have an important role to play access to adequate and nutritious foods
• Markets are rapidly changing in developing contexts
  • Longer and more complex supply chains with urbanization
  • Increases in purchase of processed foods
  • Small and medium enterprises supplying sizable share of foods
The Private Sector Has a Role to Play

- Engaging private sector actors has the potential to positively shape market food environments
- Relatively few interventions to date engaging the mid-stream private sector actors specially with the purpose of improving access to nutritious foods
- Marketplace for Nutritious Foods program – supports small and medium enterprises (SMEs) to produce nutritious foods – is an example
Challenges for Research and Evaluation

• Not a clear framework to describe the market food environment and methods to measure it
  • Recent FAO compilation of indicators for nutrition-sensitive agriculture found a paucity of food environment measures (FAO, 2016)
  • Studies of the food environment have been focused on high income countries
  • Traditional methods for impact evaluation do not apply in some more complex midstream value chain interventions

• There is a need to build on work describing the food environment and to expand the description of market food environment in developing contexts.

• Measure of the market food environments are important to understand:
  • How market food environments impact human health
  • Our ability to positively modify these via midstream supply chain interventions
1. How can we conceptualize and measure the market food environment?
   • What metrics are appropriate to assess the impact of midstream supply chain interventions aiming to improve nutrition

2. Have the activities undertaken under the Marketplace for Nutritious Foods program influenced market food environments?
A Framework to Measure the Market Food Environment
The Food Environment in Context

- Food environment is the interface that mediates one’s food acquisition and consumption within the wider food system (FEWG, 2017).

- Builds on existing concepts of food security, and encompasses personal and external factors (FEWG, 2017) including the availability, affordability, desirability and convenience of foods (Herforth and Ahmed, 2015).

- Our work focuses specifically on the market food environment, which we define as the dynamic system that both governs the delivery of food into markets and creates a context in which consumers interact with and purchase food.

Figure 1: The Food Environment within the Wider Food System (FEWG, 2017)
Measuring the Market Food Environment

- Data collection at **each point of the value chain** allows for measurement of an aspect of the market food environment.
Measurement Framework

Availability, affordability, desirability, and convenience\(^1\) of food of interest

- Consumer surveys
- Market and trader surveys
- In-depth interviews with consumers and vendors
- Value chain analysis and market mapping

Schematization of market mapping interviews

Suppliers → Processors → Wholesalers → Retailers → Consumers

\(^1\)Herforth and Ahmed, 2015
Case Study Application: Program Assessment
The Marketplace for Nutritious Foods (MNF) Program

• Provides a support to small and medium enterprises that produce nutritious foods
• Aim is to improve availability and affordability of foods in a way that is inclusive of low income consumers
• Two key program components
• 34 grant and TA recipients in Kenya, Rwanda and Mozambique since 2012
MNF Program Impact Pathway

Participation in Accelerator

Targeted financial assistance

Landscape analysis of support needed

Participation in Community of Practice

Targeted technical assistance
Increases in production volume

Increased retail locations for nutritious foods

Improved production profitability

Increases in marketing of nutritious foods

Targeted financial assistance

Landscape analysis of support needed

Targeted technical assistance

Improvements in SME management

Reductions in food loss

Increased knowledge of marketing opportunities for NF

Innovations around nutritious foods

Targeted financial assistance

Participation in Accelerator

Participation in Community of Practice

Participation in Community of Practice

Targeted technical assistance

Improvements in SME management

Reductions in food loss

Increased knowledge of marketing opportunities for NF
Increased convenience of nutritious foods

Reduction in price of nutritious foods

Increases in production volume

Improved production profitability

Increased marketing of nutritious foods

Increased desirability of nutritious foods

Increased availability of nutritious foods

Improved production profitability

Reduction in price of nutritious foods

Increased affordability of nutritious foods

Increased desirability of nutritious foods
Increased convenience of nutritious foods

Increased retail locations for nutritious foods

Increased availability of nutritious foods

Increased affordability of nutritious foods

Increased desirability of nutritious foods

Increased purchase of nutritious foods

Improved nutritional status
Case Highlight: Tarakwo Automated Milk Dispensers

- Farm cooperative near Eldoret, Kenya that aggregates and sells milk wholesale.
- With support from the Marketplace, Tarakwo began selling pasteurized milk in automated machines (ATMs).
- Consumers can purchase various quantities (as little as 5KES) dispensed into cups or take-away containers.
- In 2014, 1 other milk dispenser in Eldoret
Methods

Availability, affordability, desirability, and convenience\(^1\) of *pasteurized milk*

- **Consumer surveys**
- **Market and trader surveys**
- **In-depth interviews with consumers and vendors**
- **Value chain analysis and market mapping**

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Schematization of road to market interviews

- Suppliers → Processors → Wholesalers → Retailers → Consumers

---

\(^1\)Herforth and Ahmed, 2015
Methods

Availability, **affordability**, desirability, and convenience\(^1\) of **pasteurized milk**

- **Consumer surveys** (n=400)
- **Market and trader surveys** (n=31)
- **In-depth interviews with consumers and vendors**
- **Value chain analysis and market mapping**

---

**Schematization of road to market interviews**

1. Suppliers
2. Processors
3. Wholesalers
4. Retailers
5. Consumers

\(^1\)Herforth and Ahmed, 2015
Methods

• Cross sectional data collection
• Intervention and matched control markets identified in suburban Eldoret
• Data collection June – July 2017 shortly after severe drought
• Consumers and milk vendors randomly sampled w/in markets
  • Perceptions, purchasing habits, preferences
  • Sales, pricing
Affordability
### Pasteurized Milk Prices

**Prices of the different types of (KES/L)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Intervention market</th>
<th>Control market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw milk (hawkers)</td>
<td>50-60</td>
<td>40-50</td>
</tr>
<tr>
<td>Raw milk (shops)</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Pasteurized ATM milk</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Packed “24-hour” milk</td>
<td>100-110</td>
<td>110</td>
</tr>
<tr>
<td>Packed “long life” UHT milk</td>
<td>130-140</td>
<td>130-140</td>
</tr>
</tbody>
</table>
Pasteurized Milk Prices

Figure 1. Tarakwo Value Chain

- Cost of milk (price paid to farmers): 40
- Cost of transport from farm to plant: 3
- Cost of processing: 4
- Cost of transport from plant to ATM/city: 2
- Cost of ATM management: 2
- Gross margin: 9
- Price to end consumer: 60

Figure 2. Competitor Value Chain

- Cost of Milk (price to farmers): 36
- Transport from collection points to plant: 6
- Cost of processing: 4
- Cost of transport to city: 3
- Transport from plant to ATM/city: 4
- Moi’s Bridge Farm margin: 4
- Cost of Twin Farm ATM management: 6
- Twin Farm margin: 2
- Price to end consumer: 65
Consumers feel seasonal spikes are smaller in intervention markets

How affordable is pasteurized ATM milk on the market in the dry and rainy season?

<table>
<thead>
<tr>
<th></th>
<th>Rainy Season</th>
<th>Dry Season*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention (N=254)</td>
<td>Control (N=286)</td>
</tr>
<tr>
<td>Very affordable</td>
<td>36%</td>
<td>41%</td>
</tr>
<tr>
<td>Affordable</td>
<td>54%</td>
<td>47%</td>
</tr>
<tr>
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<td>0%</td>
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<tr>
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<td>1%</td>
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</tr>
</tbody>
</table>

* Significant at less than 0.05
Pasteurized milk tides over milk availability in the dry season

Milk Volume Sold per Vendor by Milk Type in Dry and Rainy Season (L/day)

- **Pasteurized milk**: 180 (dry season) and 111 (rainy season)
- **Raw milk**: 54 (dry season) and 58 (rainy season)
- **Mala**: 16 (dry season) and 13 (rainy season)
- **Packed milk**: 15 (dry season) and 5 (rainy season)
- **Yoghurt**: 9 (dry season) and 9 (rainy season)

- ▲ quantity sold in the dry season
- ▓ quantity sold in the rainy season
Pasteurized is more popular in MNF markets, though raw is purchased more often

Types of milk (and milk products) bought by consumers in the last 30 days

- Huruma random (N=254):
  - Yoghurt: 9%
  - Mala: 15%
  - Packed Milk: 24%
  - Pasteurized Milk: 41%
  - Raw Milk: 74%

- Langas (N=286):
  - Yoghurt: 17%
  - Mala: 23%
  - Packed Milk: 23%
  - Pasteurized Milk: 20%
  - Raw Milk: 81%
Take-away on affordability

- Price of pasteurized milk is lower in the intervention market
- Pasteurized milk tides over milk affordability in the dry season
- More consumers (including low income) purchase pasteurized milk in intervention markets
- Combination of vendor, consumer, market data allowed us to describe and understand the influence of the intervention
Value Chain Mapping: Egg Producers in Rwanda

- Trabac, medium scale egg producers in Rwanda
- Where value chains are more complex, market mapping allowed us to observe the flow of product and location of beneficiaries
- More informative measure of availability than survey data
Case Study Implications

• The market food environment provides a useful framework to evaluate private sector interventions aimed at improving nutrition.

• A measurement framework that guides data collection at consumer, vendor, and market levels provides informative and actionable results in the context of complex private sector interventions.

• Challenges remain: supply chain actors, especially SMEs, are dynamic in nature.
  • Intervention markets change. The identification of a meaningful counterfactual is a challenge.
  • Competition generated is hard to quantity.
  • Spatial and modelling approaches to measure food environment need to be further developed.
  • The work presented here is cross-sectional and exploratory in nature, and longitudinal data are needed for impact evaluation.
Revisiting the Measurement Framework

Availability, affordability, desirability, and convenience of food of interest

- Consumer surveys
- Market and trader surveys
- In-depth interviews with consumers and vendors
- Value chain analysis and market mapping
# Measuring the Market Food Environment

## Level of Measurement

<table>
<thead>
<tr>
<th>Method</th>
<th>Related Dimension</th>
<th>Potential Applications</th>
</tr>
</thead>
</table>
| Consumer surveys        | Metric            | 1. Monitor changes in consumer perception as a result of an intervention aiming to increase availability of a product  
                          |                   | 2. Understand the key features that drive food choice in planning an intervention       |
| Market and vendor surveys| Metric            | 1. Describe the volume of product availability in a market  
                          |                   | 2. Monitor changes in product availability over time (as a result of seasonality or intervention) |
| Market mapping          | Related           | 1. Ascertain product penetration in a community  
                          |                   | 2. Predict potential effects of influx of a food product (such as food aid.)            |
## Measuring the Market Food Environment

<table>
<thead>
<tr>
<th>Level of Measurement</th>
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<td>Consumer surveys</td>
<td>Likert scale perception of affordability; drivers of food choice</td>
</tr>
<tr>
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</tr>
<tr>
<td>Market mapping</td>
<td>Distance and relative quantity that the product flows from production</td>
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</thead>
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<td>Likert scale perception of affordability; drivers of food choice</td>
<td>Perceived affordability and availability, convenience and desirability</td>
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<tr>
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<td>Price; number of vendors selling product; Amount of product sold per vendor</td>
<td>Affordability and availability</td>
</tr>
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<tr>
<td>Market mapping</td>
<td>Distance and relative quantity that the product flows from production</td>
<td>Availability</td>
</tr>
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2. Understand the key features that drive food choice in planning an intervention                                                                                                                                  |
| Market and vendor surveys  | Price; number of vendors selling product; Amount of product sold per vendor | Affordability and availability                                                                           | 1. Describe the volume of product availability in a market  
2. Monitor changes in product availability over time (as a result of seasonality or intervention)                                                                                                               |
| Market mapping             | Distance and relative quantity that the product flows from production   | Availability                                                                                              | 1. Ascertain product penetration in a community  
2. Predict potential effects of influx of a food product (such as food aid.)                                                                                                                                         |
Revisiting the Measurement Framework

Availability, affordability, desirability, and convenience\(^1\) of foods of interest

- Perception based measures
- Objective measures of availability and pricing
- Contextual information to the determinants/antecedents
- Geospatial availability and flow of foods

- Consumer surveys
- Market and trader surveys
- In-depth interviews with consumers and vendors
- Value chain analysis and market mapping

\(^1\)Herforth and Ahmed, 2015
Conclusions

• Markets in part shape diets, and measuring and understanding aspects of market food environments is important for nutrition

• The market food environment is a useful concept to understand how the impact of supply chain interventions

• Combining data collected at vendor, consumer and market levels and triangulating findings is an informative methodology to assess market food environments in the context of a mid stream supply chain intervention

• Longitudinal data and imperial evidence of program impacts are needed
Acknowledgments

• Co-authors: Mduduzi NN Mbuya, Bonnie McClafferty, Tom Reardon, David Tschirely, Lynnette M Neufeld

• Technical advisory group
  – Christine Hotz, Daniel Sellen, Anna Herforth, Lidan Du, Aulo Gelli, Jessica Agnew, Mduduzi Mbuya, Jamie Lee

• Data collection partners Altai Consulting

• Funding from USAID

THANK YOU
## Characteristics of Participants

<table>
<thead>
<tr>
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<th>Intervention market (Huruma)</th>
<th>Control market (Langas)</th>
<th>Chi square P-value</th>
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<td><strong>Number of respondents</strong></td>
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<td>5%</td>
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<tr>
<td>Retired</td>
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<tr>
<td>Unemployed</td>
<td>4%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Student</td>
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<td>7%</td>
<td></td>
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<tr>
<td>Farmer</td>
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<td>31%</td>
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<td>Qualified worker</td>
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<td>Business owner</td>
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<td>&lt;5,000 KES</td>
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<td>5,001 - 10,000 KES</td>
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<td>25,001 - 50,000 KES</td>
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<td></td>
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<tr>
<td>&gt;50,000 KES</td>
<td>2%</td>
<td>6%</td>
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<td><strong>Household size</strong></td>
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<td></td>
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<tr>
<td>#HH members under 18</td>
<td>1.5</td>
<td>1.6</td>
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</tr>
<tr>
<td>#HH members under 5</td>
<td>0.6</td>
<td>0.6</td>
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</table>
Key Findings on Availability

1. **Steady increase in production and sales of pasteurized milk by Tarakwo**

2. **High seasonal availability of pasteurized milk**

3. **Consumers perceived milk to be highly available, and more so in intervention markets**

![Graph showing evolution of Tarakwo pasteurized milk sales (in 000’s liters) from 2014 to 2017 (6 months)]

![Graph showing proportion of milk volume sold by milk type over time, with data points for Raw milk, Pasteurized milk, Mala, and Yoghurt for years 2014 to 2017 (6 months)]
Key Findings on Availability

1. Steady increase in production and sales of pasteurized milk by Tarakwo

2. High seasonal availability of pasteurized milk

3. Consumers perceived milk to be highly available, and more so in intervention markets

Evolution of Tarakwo pasteurized milk sales (in 000’s liters)

Seasonal Sale (L) of Milk in Four Eldoret Markets

- raw milk
- pasteurized milk
- mala
- packed milk
- yoghurt

<table>
<thead>
<tr>
<th>Year</th>
<th>Raw Milk</th>
<th>Pasteurized Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>54</td>
<td>180</td>
</tr>
<tr>
<td>2015</td>
<td>58</td>
<td>111</td>
</tr>
<tr>
<td>2016</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>2017 (6 months)</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

*Quantity sold in the dry season* vs. *quantity sold in the rainy season*
Key Findings on Availability

1. Steady increase in sales of pasteurized milk

2. Consumers perceived milk to be highly available, and more so in intervention markets

<table>
<thead>
<tr>
<th>Intervention (n=254)</th>
<th>Control (n=286)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75% agree pasteurized milk is readily available*</td>
<td>69% agree pasteurized milk is readily available</td>
</tr>
<tr>
<td>86% agree availability has increased*</td>
<td>80% agree availability has increased</td>
</tr>
<tr>
<td>71% agree available at all times of day+</td>
<td>63% agree available at all times of day</td>
</tr>
</tbody>
</table>

* Significant at less than 0.05; significant at less than 0.01; p = 0.08
Affordability
Key findings on affordability

1. Pasteurized milk is cheaper in the intervention market.

2. Consumers perceive milk prices to be on the rise, but less so in intervention markets.

3. Consumers perceive changes in seasonal affordability to be less drastic in intervention markets.

Intervention market: 60KES/L for pasteurized milk

Control market: 65KES/L for pasteurized milk
1. Pasteurized milk is cheaper in the intervention market

2. Consumers perceive milk prices to be on the rise in light of recent drought, but less so in intervention markets

3. Consumers perceive changes in seasonal affordability to be less drastic in intervention markets

- **Intervention market**
  - 39% found price decreased
  - 61% stayed same*

- **Control market**
  - 24% found price decreased
  - 76% stayed same

* Significant at less than 0.05
1. Pasteurized milk is cheaper in the intervention market

2. Consumers perceive milk prices to be on the rise, but less so in intervention markets

3. Consumers perceive changes in seasonal affordability to be less drastic in intervention markets

### How affordable is pasteurized ATM milk on the market in the dry and rainy season?

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<td>1%</td>
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</tr>
</tbody>
</table>

* Significant at less than 0.05
Availability
Tarakwo Sales of pasteurized milk steadily increased

Evolution of Tarakwo pasteurized milk sales (in 000’s liters)

- **2014**: Initial sales
- **2015**: Moderate increase
- **2016**: Significant growth to 347,000 liters
- **2017 (6 months)**: Extrapolated sales reaching 355,000 liters

Legend:
- Pasteurized milk
- Extrapolated sales based on current sales
Tarakwo Sales of pasteurized milk steadily increased

Proportion of Milk Volume Sold by Milk Type Over Time

- 2014: 100% Raw milk
- 2015: 98% Raw milk, 2% Pasteurized milk
- 2016: 92% Raw milk, 8% Pasteurized milk
- 2017 (6 months): 58% Raw milk, 40% Pasteurized milk
Consumers perceived milk to be more available in MNF markets

<table>
<thead>
<tr>
<th></th>
<th>Intervention market (n= 254)</th>
<th>Control market (n=268)</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Pasteurized milk is readily available on this market *</td>
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<td></td>
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<tr>
<td>Strongly agree</td>
<td>10%</td>
<td>8%</td>
<td>0.03</td>
</tr>
<tr>
<td>Agree</td>
<td>55%</td>
<td>51%</td>
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</tr>
<tr>
<td>Disagree</td>
<td>30%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>3%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Respondents who think there is more pasteurized ATM milk than last year*</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>86%</td>
<td>80%</td>
<td>0.001</td>
</tr>
<tr>
<td>Respondents who think milk available at all times during the day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>71%</td>
<td>63%</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Consumers feel prices are up, but less so in intervention market

How has the price of *pasteurized ATM milk* on this market / area evolved since this time last year?*

<table>
<thead>
<tr>
<th></th>
<th>Intervention (N=254)</th>
<th>Control (N=286)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased</td>
<td>40%</td>
<td>48%</td>
</tr>
<tr>
<td>Stayed the same</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>Decreased</td>
<td>18%</td>
<td>9%</td>
</tr>
<tr>
<td>Does not consume</td>
<td>12%</td>
<td>28%</td>
</tr>
</tbody>
</table>

* Significant at less than 0.05
Steady increase in sales of pasteurized milk

Consumers perceived milk to be highly available, and more so in intervention markets

Consumers are more likely to buy from milk ATMs in intervention markets