Counterfeiting in African Agriculture Inputs – Challenges & Solutions

Comprehensive Findings

This report was prepared for the Bill and Melinda Gates Foundation in collaboration with Monitor Deloitte

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### Project Approach & Key Meetings

#### Opportunity Prioritization (2 weeks)
- **Jan 6 – Mon.**
  - (Working Group)
  - Location: Virtual
  - **Official Kick Off**
  - Align on engagement objectives and intended outcomes
  - Review engagement approach, governance, and project plan
  - Align on criteria for selecting value chains/product lines
  - Discuss and align on next steps and path forward

#### Market Research (4 weeks)
- **Jan 22 – Wed.**
  - (Working Group)
  - Location: Virtual
  - **Review of Prioritized Value Chains**
  - Review research on context and drivers of counterfeiting in Africa
  - Review research findings and analysis on value chains selection
  - Align on value chains that will be focus of market research phase
  - Discuss Nairobi stakeholder meeting design - including objectives, format, and participants

#### Solution Development (3 weeks)
- **Feb 14 – Fri.**
  - (BMGF Key Partners)
  - Location: Nairobi, Kenya
  - **Review Findings from Market Research**
  - Align on findings and insights generated from field work
  - Review the value chain maps of prioritized value chains/product lines (distribution structure, key players, incentives, drivers of counterfeiting, etc.)

- **Mar 10 – Mon.**
  - (Working Group)
  - Location: Seattle, WA
  - **Final Review of Solutions**
  - Review and align on the solutions to reducing counterfeit agri. inputs in Africa, including costs, success factors, enabling technologies, etc.
  - Review applicability of solutions across value chains studied
  - Discuss broader context in which counterfeiting occurs
  - Discuss next steps for BMGF and Deloitte’s recommendation
Executive Summary

- Smallholder farmers in Africa face significant challenges as a result of using counterfeit agricultural inputs; counterfeit products result in reduction in income, increased risk to health and safety, less access to genuine inputs, and reduced trust in inputs.

- Manufacturers of agricultural inputs lose significant value annually to counterfeit agricultural inputs; it is estimated that over $20 million is lost annually in both Ghana and Uganda due to counterfeiting.

- There are broadly six archetypes of solutions to address counterfeiting; while there are many innovative applications of the technologies used in these solutions, all anti-counterfeiting solutions will fall under one of these archetypes: End-User Authentication, Quality Assurance/Certified Channels, Smallholder Education, Track-and-Trace Technologies, Product/Package/Channel Investment by Manufacturers, or Regulatory Investment.

- We have evaluated six leading scalable solutions that have been effective in other industries to address counterfeiting; they include: Barcode Applications, Mobile Testing Kits, Coin Scratch & Mobile Authentication, Information Dissemination Platform, Inventory Management Platform, and RFID Tags.

- In order for manufacturers to invest in the solutions to counterfeiting, the cost of implementation must be less than the incremental profits generated. Certain technologies show greater promise than others in terms of their maturity, cost of implementation, and viability in addressing counterfeit inputs.

- In the near-term, we recommend that BMGF invest in piloting coin scratch & mobile authentication as a mechanism to address counterfeiting in crop protection products markets. This technology has a low cost to implement, has been proven in other industries and piloted in agriculture, and leverages technology tools that farmers are familiar with.

- However, counterfeiting is a symptom of a broader problem in African agricultural input markets: inefficient delivery channels. Over time, markets will develop as channels consolidate, farmers consolidate, manufacturers invest in Africa, farmers become more sophisticated, and technology becomes more widely adoption.

- To catalyze market development and bring increased efficiency to African agricultural input sectors, we would recommend that BMGF consider conducting a challenge prize to unlock innovations that would professionalize delivery channels.
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Counterfeiting is a challenge with global reach that spans multiple sectors; agricultural input sectors in Africa are not immune.

### Global Value Lost Due to Counterfeiting

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (Billions USD)</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>$775</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>$1,468</td>
<td>13.6%</td>
</tr>
</tbody>
</table>

### Value Lost Due to Counterfeiting: Agricultural Input Sectors in Africa

- **Crop Protection**: 
  - 2008: $0
  - 2013: $800
- **Seed**: 
  - 2008: $400
  - 2013: $1,200
- **Fertilizer**: 
  - 2008: $800
  - 2013: $1,000

Counterfeit estimates range from 15% (of total product sales) in some African markets up to 50% in others.

### Counterfeit Agricultural Inputs: Prevalence in Africa

- **Kenya**: Fake Maize Seeds Worry South Sudan Minister (October 2013)
- **Tanzania**: Amends Law to Curb Fake Fertilizers (October 2012)
- **Rwanda**: ICT to Fight Fake Agriculture Inputs (November 2013)
- **Cocoa Farmers Advised to Desist from Using Fake Pesticides** (March 2012)

- **30%**: Unlicensed or smuggled pesticides on sale in Ghana³
- **40%**: Estimate of fake seed packets in Kenya⁴
- **30%**: Counterfeit hybrid high-yielding variety seeds in Ugandan market⁵

Source: (1) BASCAP (2011); (2) Frost and Sullivan Research (2013); FAOSTAT; Hernandez and Torero (2011); Monitor Deloitte Analysis; (3) CropLife Middle East Africa (2011); (4) Kenya Agricultural Research Institute (2012); (5) Joughin (2014)
Counterfeiting in Africa’s agricultural input sectors takes multiple forms – from imitation branding and packaging to partially diluted or entirely fake products

Combinations of How Counterfeiting Occurs
(Example Highlighted in Green)

<table>
<thead>
<tr>
<th>Product</th>
<th>Brand</th>
<th>Package</th>
<th>Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentic</td>
<td>Authentic</td>
<td>Authentic</td>
<td>Licensed</td>
</tr>
<tr>
<td>Diluted</td>
<td>Imitation</td>
<td>Re-used</td>
<td>Unlicensed</td>
</tr>
<tr>
<td>Expired</td>
<td>No Brand</td>
<td>Tampered</td>
<td></td>
</tr>
<tr>
<td>Fake</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples of Counterfeit Agricultural Inputs

<table>
<thead>
<tr>
<th>Counterfeit Label and Bags</th>
<th>Re-used Brand Packaging</th>
<th>Expired Products</th>
<th>Unlicensed Producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counterfeiters change Roundup to RoundALL and fill with fake product¹</td>
<td>Yara Int’l fertilizer bags were repackaged and sold with counterfeit product²</td>
<td>Farmers in Northern Ghana lost several hectares of cotton after using expired pesticides³</td>
<td>Approximately 50% of seed companies in Uganda are unlicensed</td>
</tr>
</tbody>
</table>

Source: (1) Bloch, Kisitu, Gita (2013); (2) Kazoka (2012); (3) Ghana Web (2007);
Smallholder farmers in Africa face significant challenges as a result of using counterfeit agricultural inputs

**Reduction in Income**
Farmers who use counterfeit agricultural inputs risk significant crop damage, directly impacting their income.

**Health and Safety**
Untested and often dangerous crop protection products pose food safety, environmental, and health issues.

**Access to Genuine Inputs**
Trustworthy agro dealers are forced out of the market when they cannot compete with cheap, counterfeit manufacturers — forcing some farmers to travel further for genuine inputs.

**Trust in Genuine Inputs**
After continuing to buy counterfeits, farmers may lose trust in the efficacy of genuine inputs.

“Farmers can lose an entire season to counterfeit products”  
-- DEVELOPMENT ORGANIZATION

“There isn’t the same sort of consumer protection... we’re not talking about an FDA that monitors these issues”  
-- DEVELOPMENT ORGANIZATION

“Margins are often higher on the fake or low-quality products”  
-- IMPORTER

“It is important to find champions in farming communities... A lot of them already don’t trust us”  
-- INDUSTRY ASSOCIATION
Furthermore, manufacturers lose significant value annually to counterfeit agricultural inputs across the markets studied.

Value Lost Due to Counterfeiting

**Maize**
- Estimated losses are between $0.9M to $1.4M

**Herbicide**
- Estimated losses are between $12M to $21.5M

**Inorganic Fertilizer**
- Estimated losses are between $0.5M to $1M

**Maize Seed**: The size of seed markets in Uganda and Ghana is based on secondary research. We have applied the estimated level of counterfeiting to hybrids and OPVs separately, based on stakeholder interviews. To calculate the final estimated losses, average market prices of seed types were applied.

**Herbicide**: The total market size is based on secondary research. The primary driver of counterfeiting is bottle reuse, which was the primary rate applied to calculate total value lost. All other counterfeit activities were estimated based on stakeholder interviews in-country.

**Inorganic Fertilizer**: Market data was available through AMITSA; the calculation was only done for Uganda. Counterfeiting primarily affects smallholders, a very small segment of the market. We have estimated and applied the counterfeit rate to the total market.

**Sources**: Joughin; IFPRI (Uganda Fertilizer and Ghana seed sector studies); stakeholder interviews; Monitor Deloitte analysis
While African governments have attempted to tackle the counterfeiting challenge through legislation and policy, enforcement has not been effective

<table>
<thead>
<tr>
<th>Select Counterfeiting Policies Across Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ghana</strong></td>
</tr>
<tr>
<td><strong>Relevant Policy:</strong> Ghana’s Environmental Protection Agency (EPA) Act gives the EPA authority to prosecute for environmental crimes such as misuse of chemicals and pesticides, including selling of counterfeit products.</td>
</tr>
<tr>
<td><strong>Outcome:</strong> To date, there are no publicly recorded prosecutions of illegal traders or seizures of counterfeit agricultural inputs.</td>
</tr>
</tbody>
</table>

| **Nigeria**                                 |
| **Relevant Policy:** Nigeria’s National Agency for Food and Drug Administration (NAFDAC) was established in 1993 to regulate, control and test quality of food, drug, chemicals, etc. |
| **Outcome:** Despite laws and mandates, over 22,000 metric tons of obsolete pesticides remain on shelves with no repercussions for retailers.¹ NAFDAC is, however, enforcing laws in other sectors; for example, it has seized N10M of fake malaria drugs² |

| **Uganda**                                  |
| **Relevant Policy:** The “Seed and Plant Act 2006” requires all new varieties to be tested for two seasons before release and for “all seed offered for sale to be properly labelled and sealed”⁴ |
| **Outcome:** The lack of enforcement and legal precedent makes it difficult to prosecute counterfeit producers; for example, farmers sued Mukwano Group of Companies for selling fake seed but had limited success in court⁵ |

| **Zambia**                                  |
| **Relevant Policy:** Zambia’s Plant Variety and Seeds Act, amended in 1995, is comprehensive in outlining license and certification requirements managed by the Seed Control and Certification Institute |
| **Outcome:** Zambia has a vibrant private and public seed sector with competition in the market; commercial seed companies are actively applying for licenses — but processing times are very slow due to limited resources³ |

Source: (1) Pesticide Action Network UK (2007); (2) Udoh (2007); (3) ISSD (2012); (4) Joughin (2014); (5) Opio (2012)
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To shortlist the various value chains, we conducted an analysis that takes into account relevance to smallholder farmers, commercial attractiveness, and prevalence of counterfeiting.

**Research Criteria and Methodology**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Weighting</th>
<th>Score (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholder Relevance</td>
<td>33%</td>
<td>0 – low usage, 4 – high usage</td>
</tr>
<tr>
<td>Size of Category</td>
<td>11%</td>
<td>0 – small market size, 4 – large market size</td>
</tr>
<tr>
<td>Profitability of Category</td>
<td>11%</td>
<td>0 – low margin, 4 – high margin</td>
</tr>
<tr>
<td>Government Intervention</td>
<td>11%</td>
<td>0 – high intervention, 4 – low intervention</td>
</tr>
<tr>
<td>Prevalence of Counterfeits</td>
<td>33%</td>
<td>0 – low rates of counterfeiting, 4 – high rates of counterfeiting</td>
</tr>
</tbody>
</table>

**Example Scoring: Fungicide**

\[ \text{TOTAL SCORE FOR FUNGICIDE} = 2(0.33) + 3(0.11) + 4(0.11) + 2(0.11) + 4(0.33) = 3.0 \]

Qualitative and quantitative data was drawn from expert interviews, research and reports, and statistical databases for each value chain.

Inputs were assigned a score from 0-4 for each criteria, and a weighted average was used to calculate an overall score for each product.

(1) Percentage of smallholders growing improved varieties of quality seed was used as a proxy for purchasing rates.
### Aggregate Results of Analysis: Ghana’s Agricultural Input Sectors

<table>
<thead>
<tr>
<th>Value Chains</th>
<th>Smallholder Relevance</th>
<th>Size of Category</th>
<th>Profitability of Category</th>
<th>Government Intervention</th>
<th>Counterfeit. Prevalence</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td><img src="unfavorable" alt="Smallholder Relevance" /></td>
<td><img src="favorable" alt="Size of Category" /></td>
<td><img src="favorable" alt="Profitability of Category" /></td>
<td><img src="favorable" alt="Government Intervention" /></td>
<td><img src="favorable" alt="Counterfeit. Prevalence" /></td>
<td><strong>3.7</strong></td>
</tr>
<tr>
<td>Herbicide</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="favorable" alt="Size of Category" /></td>
<td><img src="favorable" alt="Profitability of Category" /></td>
<td><img src="favorable" alt="Government Intervention" /></td>
<td><img src="favorable" alt="Counterfeit. Prevalence" /></td>
<td><strong>3.3</strong></td>
</tr>
<tr>
<td>Fungicide</td>
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<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="favorable" alt="Profitability of Category" /></td>
<td><img src="favorable" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>3.1</strong></td>
</tr>
<tr>
<td>Insecticide</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>3.0</strong></td>
</tr>
<tr>
<td>Cowpea</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>2.7</strong></td>
</tr>
<tr>
<td>Vegetables</td>
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<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="favorable" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>2.6</strong></td>
</tr>
<tr>
<td>Inorganic Fertilizer</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>2.3</strong></td>
</tr>
<tr>
<td>Rice</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>2.1</strong></td>
</tr>
<tr>
<td>Millet</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>1.9</strong></td>
</tr>
<tr>
<td>Sorghum</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>1.7</strong></td>
</tr>
<tr>
<td>Organic Fertilizer</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>1.6</strong></td>
</tr>
<tr>
<td>Cassava</td>
<td><img src="neutral" alt="Smallholder Relevance" /></td>
<td><img src="neutral" alt="Size of Category" /></td>
<td><img src="neutral" alt="Profitability of Category" /></td>
<td><img src="neutral" alt="Government Intervention" /></td>
<td><img src="neutral" alt="Counterfeit. Prevalence" /></td>
<td><strong>1.4</strong></td>
</tr>
</tbody>
</table>

Note: Types of seeds included in analysis were selected based upon level of relevance to smallholder farmers as major staple crops.
## Results of Analysis: Maize Seed in Ghana

### Selection Criteria

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| Relevance to Smallholder Farmer    |            | ▪ As the most important staple crop in Ghana, maize is of high relevance to smallholder farmers  
                                  |            | ▪ In addition, smallholders are more likely to purchase maize certified seeds than other seed types, with approximately 22% of smallholder farmers growing improved varieties of maize |
| Size of Category / Value Chain     |            | ▪ The formal seed market in Ghana is fairly immature; however, within this market, maize captures the largest share of certified seed sold, with approximately $5M in 2011 |
| Profitability of Category / Value Chain |            | ▪ Improved maize seeds are relatively high margin, in part due to their high reproduction factor (1 seed produces 450-500 seeds) and the number of seeds required per hectare is relatively lower than other crops (~15-20 kg / hectare) |
| Level of Government Intervention   |            | ▪ The Ghanaian government continues to play a large role in its seed sector, as legislation allowing domestic private sector activity and access to foreign seed varieties was only recently passed in 2010  
                                  |            | ▪ In addition, large government subsidies have artificially lowered the price of certified maize seed by 50% |
| Prevalence of Counterfeiting       |            | ▪ There are significant reports of ‘fake seed’, mostly in the sale of market grain as seed; it has a relatively higher prevalence of counterfeiting than other seeds |

Note: Relevant sources are included in the Appendix
### Results of Analysis: Herbicide in Ghana

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance to Smallholder Farmer</td>
<td></td>
<td>▪ While handweeding is still the dominant weed control strategy for smallholders, farmers are beginning to rely more heavily on herbicides; ~17% of rural farmers currently use the product on their crops</td>
</tr>
<tr>
<td>Size of Category / Value Chain</td>
<td></td>
<td>▪ Herbicides account for over 1/3 of crop protection products sold in Ghana, with a market size of ~$44M in 2012</td>
</tr>
<tr>
<td>Profitability of Category / Value Chain</td>
<td></td>
<td>▪ While the margins on herbicide are slightly lower than on fungicide, the labor-saving benefits of herbicide are becoming increasingly attractive in Ghana as labor constraints become more important, and thus the category is fairly profitable</td>
</tr>
<tr>
<td>Level of Government Intervention</td>
<td></td>
<td>▪ Herbicides do not carry a tariff in Ghana, making it an attractive good for importers</td>
</tr>
<tr>
<td>Prevalence of Counterfeiting</td>
<td></td>
<td>▪ Incidences of counterfeit herbicides are high, with estimates in the 15-20% range</td>
</tr>
</tbody>
</table>

Note: Relevant sources are included in the Appendix
## Aggregate Results of Analysis: Uganda’s Agricultural Input Sectors

<table>
<thead>
<tr>
<th>Value Chains</th>
<th>Smallholder Relevance</th>
<th>Size of Category</th>
<th>Profitability of Category</th>
<th>Government Intervention</th>
<th>Counterfeit. Prevalence</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>3.6</td>
</tr>
<tr>
<td>Herbicide</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>3.0</td>
</tr>
<tr>
<td>Insecticide</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.9</td>
</tr>
<tr>
<td>Fungicide</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.9</td>
</tr>
<tr>
<td>Rice</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.4</td>
</tr>
<tr>
<td>Cassava</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.4</td>
</tr>
<tr>
<td>Inorganic Fertilizer</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.4</td>
</tr>
<tr>
<td>Vegetables</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.2</td>
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<tr>
<td>Sorghum</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>2.2</td>
</tr>
<tr>
<td>Yam</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1.7</td>
</tr>
<tr>
<td>Millet</td>
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<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1.7</td>
</tr>
<tr>
<td>Organic Fertilizer</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Maize seeds are included to compare seed markets in Ghana and Uganda. Follow-up interviews in Uganda, highlighted herbicide was in fact the most highly counterfeited CPP.*

*Initial interviews suggest that the inorganic fertilizer market would be an interesting one to study in a landlocked country given the complex distribution chains, lack of local production, and commoditized product.*

Note: Types of seeds included in analysis were selected based upon level of relevance to smallholder farmers as major staple crops.
### Results of Analysis: Herbicide in Uganda

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Relevance to Smallholder Farmer</td>
<td>![Unfavorable]</td>
<td>▪ Smallholder farmers’ usage (~9.5% of smallholder farmers) of herbicide is reflective of low use across all crop protection products in Uganda</td>
</tr>
<tr>
<td>2 Size of Category / Value Chain</td>
<td>![Unfavorable]</td>
<td>▪ The market for herbicide in Uganda is currently valued at ~$6M, and imports have been growing rapidly since 2002</td>
</tr>
<tr>
<td>3 Profitability of Category / Value Chain</td>
<td>![Favorable]</td>
<td>▪ With low cost herbicide products entering the market from China/India, the margins are high for herbicides in Uganda</td>
</tr>
<tr>
<td>4 Level of Government Intervention</td>
<td>![Unfavorable]</td>
<td>▪ The government has taken a fairly hands-off approach to herbicides in Uganda, neither subsidizing nor intervening in the market</td>
</tr>
<tr>
<td>5 Prevalence of Counterfeiting</td>
<td>![Favorable]</td>
<td>▪ Counterfeit products are prevalent, with infiltration of fake herbicides higher than 40% in some locations</td>
</tr>
</tbody>
</table>

Note: Relevant sources are included in the Appendix
## Results of Analysis: Inorganic Fertilizer in Uganda

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance to Smallholder Farmer</td>
<td></td>
<td>• Usage rates of inorganic fertilizer in Uganda are currently very limited (~1% of smallholders); farmers find it difficult to access fertilizer at a price that will allow them to obtain sufficient return on their investment</td>
</tr>
<tr>
<td>Size of Category / Value Chain</td>
<td></td>
<td>• The market is valued at approximately $24M, and demand is growing as soil fertility continues to decline</td>
</tr>
<tr>
<td>Profitability of Category / Value Chain</td>
<td></td>
<td>• Fertilizer is largely a “bulk” commodity, with margins as low as 4-5%</td>
</tr>
<tr>
<td>Level of Government Intervention</td>
<td></td>
<td>• No fertilizer subsidies are currently in place in Uganda, and government intervention in the market is low</td>
</tr>
<tr>
<td>Prevalence of Counterfeiting</td>
<td></td>
<td>• Given the landlocked location of Uganda, and the high degree of intermediation along the fertilizer distribution channel, there are numerous opportunities to adulterate the product</td>
</tr>
</tbody>
</table>

### Note:
Relevant sources are included in the Appendix
In summary, based on our research and analysis we recommend focusing on maize seeds and herbicide in Ghana, and herbicides, maize seeds and inorganic fertilizer in Uganda.

Proposed Value Chain Selection:

Ghana

- Maize Seeds
- Herbicide

Uganda

- Herbicide
- Inorganic Fertilizer

Note: Maize seed was also added to the analysis in order to compare insights across geographies.
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    - Uganda: Maize Seeds
    - Uganda: Inorganic Fertilizer
- Assessment of Technological Environment in Ghana & Uganda
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- Path Forward & Recommendation
In summary, counterfeiting prevalence in Ghana is much higher within the herbicide market than in the maize seed market

### Summary of Prevalence of Counterfeiting Across Value Chains Studied

<table>
<thead>
<tr>
<th>Counterfeiting within herbicides</th>
<th>Counterfeiting within maize</th>
</tr>
</thead>
</table>

While counterfeiting occurs within both herbicides and maize, prevalence is much higher in herbicides. Ghana’s maize seed sector is still quite nascent; the sector is largely commoditized – a single low-priced OPV (Obatanpa) captures the majority of seed market. As a result, counterfeiting is not nearly as pervasive in seeds as it is in herbicides.

### Summary of Types of Counterfeiting

#### Herbicides
- **Mislabeled / Sub-standard product** in which the label does not reflect contents in the bottle (often Chinese imports)
- **Label Reuse / Sub-standard product** in which a premium product’s label is placed on a bottle of sub-standard product
- **Bottle Reuse / Adulterated product** in which premium bottles are refilled with diluted or fake product
- **Label Imitation / Sub-standard or Adulterated Product** in which a premium brand is imitated, but the product is sub-standard or adulterated

#### Maize Seeds
- **Mislabeled / Incorrect Seed** in which seed growers, companies, and agro-dealers place grains in the government-issued seed packages, and label them OPV or hybrid varieties.
- **Label Imitation / Adulterated or Sub-standard Seed** in which private seed companies packages are imitated/replicated and grains are sold as OPV or hybrid varieties (very rare given limited number of companies producing their own packages)
- **Mislabeled / Diluted Seed** in which seed growers “top-up” orders with grains in order to meet contracted amount
Several efforts have been piloted to address counterfeiting in Ghana; however, each has potential shortcomings (1 of 2)

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Initiative Name</th>
<th>Description</th>
<th>Key Learnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality Assurance / Certified Channels</strong></td>
<td>Spray Service Provider Project</td>
<td>▪ Piloted by CropLife and ADVANCE (a USAID project) in the Ashanti region</td>
<td>▪ Reduces the level of intermediation that occurs along the value chain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Young unemployed graduates are trained to become sprayers and to use genuine agrochemicals, with which they spray farmers’ fields for a fee</td>
<td>▪ However, success of the program is contingent upon building high levels of credibility among farming community</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ 486 sprayers have been trained to spray farms in 8 communities thus far</td>
<td>▪ In addition, a risk of spray providers deciding to engage in fraud remains</td>
</tr>
<tr>
<td><strong>Smallholder Education</strong></td>
<td>Container Collection Program</td>
<td>▪ CropLife, in collaboration with PPRSD and the EPA, initiated a collection program for farmers’ empty pesticide containers</td>
<td>▪ Decreases the number of containers that could potentially be reused by counterfeiters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ 13 collection bins have been placed around the Ashanti region, and 15k-30k bottles are collected annually (~0.3% of market)</td>
<td>▪ However, dependent upon autonomous opt-in by farmers, and does not address sub-standard counterfeits</td>
</tr>
<tr>
<td><strong>End-User Authentication</strong></td>
<td>Verified Brand Scheme</td>
<td>▪ CropLife (funded by Bayer) piloted the use of “Holospots” on Confidor, an insecticide for cocoa</td>
<td>▪ Effectively verifies that the product was produced by the stated manufacturer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Each container was marked with a hologram, which was verified by viewing under direct light and tilting the label</td>
<td>▪ However, holograms proved difficult to use, given farmers’ unfamiliarity with the technology and illegibility of the hologram</td>
</tr>
</tbody>
</table>

(1) Note: See appendix for additional information on key industry associations and extension networks
Several efforts have been piloted to address counterfeiting in Ghana; however, each has potential shortcomings (2 of 2)

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Initiative Name</th>
<th>Description</th>
<th>Key Learnings</th>
<th>Sector Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCT, PACKAGE OR CHANNEL INVESTMENT</strong></td>
<td>Seed Dyes</td>
<td>▪ Pannar and Pioneer hybrid maize seeds are dyed red to visually distinguish them from grain and other types of certified seed</td>
<td>▪ Unique dyes enable farmers to more easily identify counterfeit seed</td>
<td>□ CPPs □ Seeds □ Fertilizer</td>
</tr>
<tr>
<td><strong>QUALITY ASSURANCE / CERTIFIED CHANNELS</strong></td>
<td>Masara Outgrower Scheme</td>
<td>▪ Farmers association sponsored by Yara and Wienco, in which inputs are supplied to farmers on credit and repaid after harvest (only quality inputs are used)</td>
<td>▪ Minimizes the level of intermediation in the channel, thus effectively ensuring that product integrity is preserved</td>
<td>□ CPPs □ Seeds □ Fertilizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Currently covers Brong-Ahafo, Northern, Upper West and Upper East regions</td>
<td>▪ However, requires high degree of investment in channel, and may not be easily scalable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Planting for the year 2013 amounted to 22,000 acres for more than 5,000 farmers</td>
<td>▪ However, possibility that sophisticated counterfeiters learn to mimic these seed dyes remains</td>
<td></td>
</tr>
</tbody>
</table>

(1) Note: See appendix for additional information on key industry associations and extension networks
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Herbicides in Ghana represent a $44 M market – low-priced Glyphosates sold in 1 liter containers constitutes a majority of the market.

**Crop Protection Market in Ghana**

- **Herbicide**: $113M (39% of Total CCP Market)
- **Fungicide**: $44M (40% of Total Herbicide Market)
- **Insecticide**: $44M (21% of Total Herbicide Market)

**Price Range for 1 Liter of Herbicide**

- **Glyphosate**: $5 – $10
- **Paraquat**: $4 – $6
- **2, 4-D Amine**: $5 – $7
- **Other**: $4 – $10

The majority of 1L Glyphosate sold is for less than 7 USD.

**Leading Brands in the Herbicide Sector**

- While brand choice is a strong driver of purchasing behavior, the herbicide market is highly fragmented, with ~40 different varieties of glyphosate registered (over 60% of which are generic varieties).
- Most popular brands with smallholders include RoundUp, Rival, Dursban, and Kalach, but these brands are not always available in the channel.

**SKUs**

- **250 mL**: Very infrequently sold
- **500 mL**: Sold infrequently (~5% of volume sold)
- **1 L**: Most popular size (~73% of volume sold)
- **5 L**: Less popular size (~22% of volume sold)

Ghana’s Crop Protection Product market is well regulated; manufacturers and importers must undergo rigorous testing before products can be distributed

Key Players

ENVIRONMENT PROTECTION AGENCY (EPA) – Responsible for protecting and improving the environment of Ghana, which includes writing legislation on the production and use of agro-chemicals

PLANT PROTECTION & REGULATORY SERVICES DEPARTMENT (PPRSD) – Organizes, regulates, and implements plant protection services, including: plant imports/exports, seed inspection, and agro-chemical regulations

PLANT & FERTILIZER REGULATORY DIVISION (PFRD) – Division of the PPRSD that regulates the agro-chemical sector; registers and trains agro-chemical dealers and applicators; manages agro-chemical stock; supervises agro-chemical research

Relevant CPP Regulations

PLANTS AND FERTILIZER ACT, 2010 (ACT 803): Stipulates that “a person shall not import, manufacture or distribute fertilizers in commercial quantities unless the person is registered [with the PPRSD].”

ENVIRONMENTAL PROTECTION AGENCY ACT 490 (1994): Mandates that the EPA and the PFRD carry out all regulatory activities within the pesticide market; gives the EPA authority to prosecute for environmental crimes such as misuse of chemicals and pesticides, including selling of counterfeit products

Steps to Become A Licensed CPP Importer or Manufacturer

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
<th>Step 5</th>
<th>Step 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Register product &amp; company with PPRSD and request permit to import sample</td>
<td>PPRSD conducts lab analysis to verify active ingredient</td>
<td>PPRSD conducts field trial to prove product effectiveness</td>
<td>PPRSD makes decision on registration</td>
<td>Product can now be distributed and sold in Ghana for the next year</td>
<td>Company renews registration annually through repeating process</td>
</tr>
</tbody>
</table>

Entire process takes 6-12 months to complete for a cost of ~US$ 2000

Source: (1) Interviews conducted with Plant Protection & Regulatory Services Department (PPRSD), and department website
The majority of herbicides sold in Ghana are imported in a finished form; while some companies import chemicals and mix domestically, there is no domestic manufacturing

### Key Players

- **MNCs (~40)**
  - While some companies mix their own formulations, all chemical manufacturing is done abroad – mainly China (~80%) and Europe (~20%)
  - Leading importers include: Calli Ghana, Wienco, Reiss & Co and Dizengoff
  - Leading companies that import chemicals and mix domestically include: Chemico and Wynca Sunshine
- **Import Companies (~15)**
  - Agents/distributors buy in bulk from importers, and store the CPP in their own warehouses
  - Agro-dealers may also purchase from importers, but only in large volumes
  - Mobile/rural retailers operate primarily in rural areas and do not own their own storefronts
- **Agents/Distributors**
  - Agents/distributors buy in bulk from importers, and store the CPP in their own warehouses
- **Consumers**
  - Major importers often sell directly to large-scale farms, while smallholders purchase inputs from local agro-input dealers, including mobile/rural retailers
  - Large farms include cocoa, cotton, and rubber plantations, farmer cooperatives, and out grower schemes

### Overview

- **While some companies mix their own formulations, all chemical manufacturing is done abroad – mainly China (~80%) and Europe (~20%)**
- **75% of the CPP market consists of pesticides imported in a finished, ready to use form**
- **Remaining 25% consists of companies importing chemicals and mixing in-country**
- **~3,425 distributors, ranging from very small independent retailers to large wholesalers**
  - The majority of input dealers belong to the Ghana Agricultural Input Dealers Association (GAIDA), which was established with donor assistance in 2003
- **Mobile/rural retailers**
  - Operate primarily in rural areas and do not own their own storefronts
  - ~3,425 distributors, ranging from very small independent retailers to large wholesalers
  - The majority of input dealers belong to the Ghana Agricultural Input Dealers Association (GAIDA), which was established with donor assistance in 2003
- **Major importers often sell directly to large-scale farms, while smallholders purchase inputs from local agro-input dealers, including mobile/rural retailers**
  - Large farms include cocoa, cotton, and rubber plantations, farmer cooperatives, and out grower schemes

---

1 Note: An additional transaction may exist in which a retailer sells to another mobile/rural retailer
Counterfeiting within the herbicide sector in Ghana primarily occurs in one of three forms . . .

1. **Mislabeled / Sub-standard Product** that is imported into the country and flows through the supply chain; in such cases, the formulation on the label does not represent the actual formulation in the bottle (i.e. bottle says 41%, but it is actually ~30% concentrate); reduced concentration products do have some efficacy, but not to the extent one would expect based on the label; in such cases, this occurs in 1 liter bottles of glyphosate manufactured by Chinese companies which are sold as some of the cheapest varieties on the market.

   ~30%

2. **Package Reuse / Adulterated or Sub-standard Product** occurs at the agro-dealer level and takes one of two forms:
   1. **Label Reuse**: The herbicide sold is low-quality authentic herbicide, but the label is removed and a copy of a premium-brand’s label is printed and pasted on the herbicide bottle. This occurs in instances when there is high-demand for a premium brand.
   2. **Bottle Reuse**: Authentic premium-brand empty bottles are refilled with either adulterated (diluted) product or substandard product (expired).

   ~50%

3. **Label Imitation / Adulterated or Sub-standard Product** in which a replica brand/label is printed that has a slight variation of an authentic brand’s name (see appendix for example) and the product inside is sub-standard.

   ~20%

**Estimate of breakdown of counterfeit herbicide market**
Drivers of Counterfeiting in Ghana’s Herbicide Market

1. **Package Integrity across Distribution Chain**
   - **High Degree of Intermediation** – The supply chain for herbicides is highly fragmented. Rather than having established contracts with 1 or 2 distributors, agro-dealers will often source their product from multiple different intermediaries, as well as sell to several agro-dealers further down the supply chain. In addition to a lack of vertical integration, the product will change hands 4-6 times before it reaches the consumer.

2. **Manufacturers Willingness to Intervene**
   - **Out-of-Stocks of Reputable Brands** – Brands play a key role in the purchasing decisions of smallholder farmers; if they cannot buy the brand they want, they may not purchase a herbicide at all. During periods of limited supply in semi-urban and rural areas, agro-dealers are thus incentivized to provide the brand the farmer wants through counterfeiting activities.
   - **Limited Channel Oversight** – After the manufacturer sells the herbicide to the importer, very little is done to ensure that the product/package is not adulterated.

3. **Smallholder Context/Behaviour**
   - **Difficulty Identifying Adulterated or Sub-Standard Herbicides** – It is difficult for farmers to determine if a label has been tampered with or if the label represents the formulation actually in the bottle. Farmers typically won’t know if the product is authentic for weeks after usage. Because of this uncertainty, farmers will often simply choose the cheapest alternative (in which case the opportunity cost is the lowest), which is likely a counterfeit.

4. **Distribution Chain Actors’ Behaviour**
   - **Profit Potential of Selling Counterfeits** – Counterfeit herbicides command a higher profit margin than authentic herbicides (see appendix for analysis); as such, producers of counterfeit will source identical packaging from China and fill it with sub-standard or adulterated materials in order to make greater profitability.

Drivers of counterfeiting are interrelated and do not function in isolation.
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The market for certified maize seed is in Ghana is still relatively nascent, and dominated by a single open-pollinated variety brand.

### Maize Seed Market in Ghana

- **Certified Seed**: 20%
- **Informal Seed Market**: 80%
- **Open Pollinated Variety**: 94%
- **Foreign Hybrid**: 5%
- **Local Hybrid**: 1%

### Price Range for 1 kg of Maize

<table>
<thead>
<tr>
<th>Variety</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>0.4</td>
</tr>
<tr>
<td>OPV</td>
<td>1.2</td>
</tr>
<tr>
<td>Local Hybrid</td>
<td>2.5</td>
</tr>
<tr>
<td>Foreign Hybrid</td>
<td>5.3</td>
</tr>
</tbody>
</table>

### Maize Seed Packaging

- Maize seed is typically sold in 1 kg government-issued bags, which indicate the seed variety and seed company/grower.
- Up until 2010, the PPRSD prescribed these uniform seed packages for all sale of maize seed.
- This law has since been revised, and seed companies may apply to use their brand on product packaging; however, only 3 domestic seed companies have proprietary packaging thus far.

### Maize Brands Sold

- The maize seed market in Ghana is highly commoditized
  - A single OPV, Obatanpa, constitutes the vast majority of domestic maize seed production
  - Private labeling of brands only began in the past year
- Wienco and AgriServ have recently begun promoting imported hybrid varieties, from Pannar and Pioneer, respectively, though these are rarely used by smallholder farmers.

Ghana’s certified seed market is regulated by the GSID; seed growers and importers must go through an in-depth registration and testing process before seeds can be sold and distributed.

**Key Players**

**Plant Protection & Regulatory Services Department (PPRSD)** – Organizes, regulates, and implements plant protection services, including: plant imports/exports, seed inspection, and agro-chemical regulations

**Ghana Seed Inspection Division (GSID)** – Division of the PPRSD that regulates the seed sector; registers and certifies seed growers / companies; supervises seed breeding research; monitors quality of seed, and facilitates promotional activities in the seed industry

**National Seed Council (NSC)** – Responsible for policy formulation related to the development, production, inspection, sampling, analysis, conditioning and marketing of seeds in Ghana

---

**Relevant Seed Regulations**

**Part II of Plants and Fertilizer Act, 2010 (Act 803):** The law includes designation of responsibilities for seed import and export, establishes a register of varieties that can be marketed, outlines procedures for seed quality control and testing, and establishes a National Seed Council and associated committees

---

**Steps to Become A Certified Seed Grower / Company**

**Step 1**

*Prospective seed growers and companies register with the GSID*

**Step 2**

*GSID inspects their fields, processing, and storage facilities*

**Step 3**

*Samples are drawn for testing, and purity, moisture content, seed health are assessed*

**Step 4**

*GSID approves seeds for sale and provides official Ministry of Agriculture tag*

**Step 5**

*Inspectors re-visit production site to ensure growing conditions are being met*

**Step 6**

*Seed companies and growers renew their registration on a seasonal basis through repeating registration process*

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*Initial registration takes ~12 months to complete and is valid for 2 years, after which registration is renewed on a seasonal basis*

Source: (1) Interviews conducted with Plant Protection & Regulatory Services Department (PPRSD), seed companies, and MOFA website
Seed “companies” in Ghana have only recently emerged; the majority of seed producers are small-scale individual farmers that rely on government-produced breeder and foundation seed.

Overview

Key Players

Developers

- Government agencies and research institutions produce breeder / foundation seeds
- Much of the funding for this plant breeding research has come, directly or indirectly, from donor projects

Researchers

- Ghana’s national agricultural research institutes (NARIs), principally Crops Research Institute (CRI) and Savannah Agricultural Research Institute (SARI) develop breeder seed varieties
- Using this seed, the Grains and Legumes Development Board (GLDB) produces foundation seed

Producers

- Most seed producers buy foundation seed from GLDB at subsidized prices, while a few seed companies buy breeder seed directly from the CRI
- There are ~1,500 certified seed growers ranging in size from individual farmers to small seed companies

Contract Grower

- ~600 seed producers are active members of the Seed Producers Association of Ghana (SEEDPAG)
- GHASTA is new formation of seed companies, and currently still in the registration process
- Only 3 seed companies have private branded packaging: M&B, Mabert, and Antika

Distribution

- While seed companies sell primarily through agro-dealers, some also have their own distribution channels
- NGOs buy seed from seed companies to donate to farmers, and the government purchases seed for use in block farming schemes

- ~50% of agro-dealers sell certified maize seed
- The government’s block farming program brings numerous farmers together on large production areas and provides them with inputs on credit; the farms currently span approximately 45k ha

- Large farms may include large-scale commercial farms or farmer cooperatives

Consumers

- Most farmers acquire a new maize variety from other farmers or from extension agents (external providers of training or inputs) - few farmers regularly purchase seed from agro dealers or seed companies

Note: A small imported seed market is also present in Ghana, but counterfeiting is not a prevalent issue due to size of market and high degree of vertical integration; refer to the appendix for further information on distribution chain.

Counterfeiting within the maize seed sector in Ghana primarily occurs in one of three forms . . .

Mislabeled / Incorrect Seed occurs when the seed-type packed in the bag does not represent the variety or quality of seed indicated on the label. This is carried out by seed growers, agro-dealers, or other individuals, and can take two forms:
1. Seed growers selling grain as seed, or OPVs as hybrid seeds in government-issued bags
2. Agro-dealers or other individuals illicitly obtaining government issued bags and filling them with grains

Label Imitation / Adulterated or Sub-standard Seed occurs at the agro-dealer level, in which private seed companies packages are imitated/replicated; for example, imitation Mabert and M&B bags have appeared on agro-dealer shelves (Note: this instance of counterfeiting is relatively rare given the vast majority of seeds are still sold in government packages, but potential to increase as more companies move toward private branding)

Mislabeled / Diluted Seed is a response by seed growers to constrained supply. In the event of drought or other natural disasters, or when seed production is low, NGOs and government block farms will issue large orders for seed in order to ensure food security. When growers cannot meet the contracted amount with genuine seeds produced, they dilute quantities by adding grain to the order

Source: Primary interviews

~80%
~5%
~15%

Estimate of breakdown of counterfeit seed market
Drivers of Counterfeiting in Ghana’s Maize Seed Market

<table>
<thead>
<tr>
<th>Drivers of Counterfeiting</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government-Issued Seed Packages</strong></td>
<td>The GSID provides standard plastic seed bags; these bags are easy to imitate, and relatively easy to acquire (until 2010, use of these packages by seed companies was mandated).</td>
</tr>
<tr>
<td><strong>Market Fragmentation</strong></td>
<td>With ~1,500 seed producers for a relatively small market, the majority of maize seed suppliers are small-scale growers participating in a highly commoditized market. This market fragmentation makes it difficult to identify the source of counterfeit seeds.</td>
</tr>
<tr>
<td><strong>Limited Product or Packaging Innovation</strong></td>
<td>Only three domestic seed companies have made investments in proprietary packaging (since the law changed in 2010); a lack of packaging variety in Ghana’s nascent seed sector lowers barriers to counterfeiting activities.</td>
</tr>
<tr>
<td><strong>Difficulty Identifying Poor Quality or Diluted Seeds</strong></td>
<td>It is very for smallholder farmers to determine the quality of a seed based on sight alone—seed and grain are almost indistinguishable. Furthermore, if yields are lower than expected, a number of other factors could have been the cause—from proper fertilizer usage to weather. Therefore, identifying and tracing the sale of counterfeit seed proves difficult for seed consumers.</td>
</tr>
<tr>
<td><strong>Profit Potential of Selling Counterfeits</strong></td>
<td>The seed market in Ghana is subject to large swings in supply and demand. In times of low seed production or natural disaster, NGOs and government block farms issue large seed orders to ensure food security. In addition, when the price of grain rises due to constrained supply, farmers turn to buying more seed instead of grain. These volatile market dynamics drive registered growers to sell grains or impure seeds in order to meet escalating demand, and unlicensed individuals to capitalize upon the rise in seed price by selling counterfeit seed.</td>
</tr>
</tbody>
</table>

Drivers of counterfeiting are interrelated and do not function in isolation.
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  - Ghana: Overview & Existing Initiatives to Address Counterfeiting
  - Ghana: Herbicide
  - Ghana: Maize Seeds
  - **Uganda: Overview & Existing Initiatives to Address Counterfeiting**
    - Uganda: Herbicide
    - Uganda: Maize Seeds
    - Uganda: Inorganic Fertilizer
- Assessment of Technological Environment in Ghana & Uganda
- Summary of Solutions
- Assessment of Each Solution
- Applicability of Solutions
- Path Forward & Recommendation
Among the value chains studied, counterfeiting prevalence in Uganda is highest within the herbicide market, followed by the maize seed market and the fertilizer market.

**Summary of Prevalence of Counterfeiting Across Value Chains Studied**

The prevalence of counterfeiting is highest within herbicides. Counterfeiting in maize seeds – especially among hybrid varieties – is also prevalent, but less so than in herbicides. Smallholder farmers rarely use fertilizer and therefore counterfeiting is not as prevalent as in the other two value chains (but remains a recognized issue).

**Summary of Types of Counterfeiting**

<table>
<thead>
<tr>
<th>Herbicides</th>
<th>Maize Seeds</th>
<th>Fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Mislabeled / Sub-standard Product in which the label does not reflect contents in the bottle (often Chinese imports)</td>
<td>- Mislabeled / Diluted Seed in which seed growers “top-up” orders with grains in order to meet contracted amount or mobile salesmen sell grains mixed with seeds out of the back of trucks</td>
<td>- Mislabeled / Underweight Product in which fertilizer is removed from bag and then the bag is resealed</td>
</tr>
<tr>
<td>- Label Reuse / Sub-standard Product in which a premium product’s label is placed on a bottle of sub-standard product</td>
<td>- Label Imitation / Adulterated or Sub-standard Seed in which imitation packages of leading seed companies are produced and filled with grain and/or fake seeds</td>
<td>- Mislabeled / Diluted Product in which agro-dealers dilute fertilizer with ash or sand during re-packaging</td>
</tr>
<tr>
<td>- Bottle Reuse / Adulterated Product in which premium bottles are refilled with diluted or fake product</td>
<td>- Label Reuse / Adulterated Seed in which agro dealers acquire and re-use bags of reputable seed companies</td>
<td>- Mislabeled / Adulterated Product in which large packages are broken into smaller packages and fake materials are placed in the small packages</td>
</tr>
<tr>
<td>- Label Imitation / Sub-standard or Adulterated Product in which a premium brand is imitated, but the product is sub-standard or adulterated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Several efforts have been piloted to address counterfeiting in Uganda; however, each has potential shortcomings (1 of 2)

### Key Anti-Counterfeiting Initiatives

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Initiative Name</th>
<th>Description</th>
<th>Key Learnings</th>
<th>Sector Applicability</th>
</tr>
</thead>
</table>
| **End-User Authentication**   | SMS Verification Pilot               | - 18-month pilot funded by USAID and implemented by CropLife, IFDC, and Grameen Foundation to test e-verification/coin-scratch technology  
- Conducted retailer training and farmer outreach to discourage counterfeit crop protection products  
- 76 agro-dealers participated; 30,000 packages sold with coin scratch labels                                                                 | - Coin-scratch label drove sales; market share of pilot products doubled  
- If code is authenticated, effectively verifies that the product was produced by the stated manufacturer  
- However, there is some concern that counterfeiters will take advantage of farmers who do not text in the code (7.3% of products were authenticated) | CPPs, Seeds, Fertilizer |
| **Smallholder Education**     | Video Blasts & Training Program      | - Funded by aBi Trust, CropLife collaborated with the Ministry of Agriculture to develop videos warning against the effects of counterfeit goods  
- Videos were translated into 4 languages and screened approximately 100 times over 2 years in Northern Uganda villages  
- Simultaneously, aBi Trust funded a project to educate extension officers, NGOs, and agro dealers on counterfeit inputs | - Anecdotal evidence shows the project was successful in sensitizing farmers in rural villages  
- 17,000 people viewed the video and CropLife received many requests for additional viewings; farmers were receptive and engaged  
- Despite increased education and awareness surrounding the issue, counterfeiters are getting more and more sophisticated so that even with training it is difficult to discern between genuine and fake products | CPPs, Seeds, Fertilizer |

(1) Note: See appendix for additional information on key industry associations and extension networks
Several efforts have been piloted to address counterfeiting in Uganda; however, each has potential shortcomings (2 of 2)

## Anti-Counterfeiting Initiatives Continued

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Initiative Name</th>
<th>Description</th>
<th>Key Learnings</th>
<th>Sector Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QUALITY ASSURANCE &amp; TRACK AND TRACE TECHNOLOGY</strong></td>
<td>Feed the Future</td>
<td>- The USAID-funded project has 2 primary anti-counterfeiting components: 1. Improvement of the regulatory environment through the facilitation of industry associations to lobby government players 2. Market-facing anti-counterfeiting initiatives; activities under consideration include: anti-counterfeiting hotline; e-verification; preferred distributor program</td>
<td>- Feed the Future initiatives have only been underway for 6 months; therefore, it is difficult to assess the project’s activities</td>
<td>✔ CPPs ✔ Seeds ☐ Fertilizer</td>
</tr>
<tr>
<td><strong>PRODUCT, PACKAGE, OR CHANNEL INVESTMENT</strong></td>
<td>Tamper-Proof Packaging</td>
<td>- Private companies have invested in high-end packaging material and labels that are more difficult to imitate or re-use (e.g., NASECO invested in local packaging equipment to create bags that are more difficult to counterfeit)</td>
<td>- Improved packaging deters some forms of fraud, however packages did not include technologies to tackle counterfeiting (e.g., end user authentication)</td>
<td>✔ CPPs ✔ Seeds ✔ Fertilizer</td>
</tr>
</tbody>
</table>
| **SMALLHOLDER EDUCATION**              | Radio Programs           | - Private companies, such as Monsanto and Keith Associates, use radio programming to raise awareness of counterfeits and encourage people to call in with questions about counterfeit products | - Helps farmers more easily identify counterfeit products  
- However, education alone may not be sufficient to prevent counterfeiting without coupling with another solution (e.g., quality assurance, end-user verification) | ✔ CPPs ✔ Seeds ☐ Fertilizer |

(1) Note: See appendix for additional information on key industry associations and extension networks
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Herbicides in Uganda represent a ~US$18M market – low-priced Glyphosates sold in 1 liter containers constitutes a majority of the market

**Crop Protection Market in Uganda**

- ~US$30M
  - Herbicide: 60%
  - Insecticide: 25%
  - Fungicide: 15%

- ~US$18M
  - Glyphosate: 75%
  - 2, 4-D: 15%
  - Other: 10%

**Price Range for 1 Liter of Herbicide**

- Glyphosate: 9
- 2, 4-D: 6
- Other*: 9

*“Other” includes Ametryne, Paraquat, Butanyl, etc.

**Leading Brands in the Herbicide Sector**

- The most popular glyphosate is a Chinese generic under the WeedMaster trade-name (distributed by Bukoola)
- There are currently 48 generic brands on the Ugandan herbicide market (WeedUp, RoundAll, WeedAll, etc.)
- Brand choice is a strong driver of purchasing behavior, but most farmers can only afford generic varieties. Leading premium brands include RoundUp and Mamba

**SKUs**

- 500 mL: Less popular size (~5% of volume sold)
- 1 L: Most popular size (~80% of volume sold)
- 5-20 L: Less popular sizes (~15% of volume sold)

Source: (1) Expert interviews, Monitor Deloitte field research.
The regulatory environment in Uganda is evolving – implementation and enforcement is relatively poor

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Relevant CPP Regulations¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CROP INSPECTION AND REGISTRATION DEPARTMENT (CIRD)</strong> – Newly mandated department (2013) to license agro dealers and importers; assess and certify quality of agro-chemicals; monitor and enforce compliance of agro-chemical regulations in imports and exports</td>
<td><strong>NATIONAL AGRICULTURE ADVISORY SERVICES ACT (2001)</strong>: Mandates the provision of agricultural advisory services to improve farmer’s access to quality inputs and farming practices; responsible for extension services across Uganda</td>
</tr>
<tr>
<td><strong>CROP PROTECTION BOARD (CPB)</strong> – In coordination with CIRD, approves registration of crop protection products and ago-dealers; the Agricultural Chemicals Control Technical Committee reports to and makes recommendations to CPB</td>
<td><strong>CONTROL OF AGRICULTURAL CHEMICALS ACT (2006)</strong>: Requires any agro-chemical manufactured, stored, imported or distributed in Uganda to be registered, packaged and labeled</td>
</tr>
<tr>
<td><strong>UGANDA NATIONAL BUREAU OF STANDARDS (UNBS)</strong> – Mandated (within the Ministry of Trade) to enforce the use of standards across industries primarily at points of entry</td>
<td><strong>AGRO-CHEMICAL REGULATIONS (2011) - DRAFT</strong>: Regulatory framework that outlines how to monitor and enforce the law (Control of Agricultural Chemicals Act); calls for additional resources for regulators and stricter punishments for counterfeiting – the framework has not yet been approved by the ministry</td>
</tr>
<tr>
<td><strong>UGANDA NATIONAL AGRO DEALER ASSOCIATION (UNADA)</strong> – represent Ugandan agro dealers, providing professional support and enforcing good business practices among members. UNADA has ongoing lobbying efforts for stricter counterfeit regulation</td>
<td></td>
</tr>
</tbody>
</table>

| Steps to Register a Crop Protection Product and Company in Uganda¹ |
|-----------------|------------------|----------------|-----------------|-----------------|------------------|
| **Step 1** | **Step 2** | **Step 3** | **Step 4** | **Step 5** | **Step 6** |
| **IMPORTER OR MANUFACTURER OF CPP** | **REGISTER PRODUCT & COMPANY WITH CIRD** | **CIRD COMMISSIONS LAB ANALYSIS TO VERIFY ACTIVE INGREDIENTS** | **CIRD CONDUCTS FIELD TRIAL TO PROVE PRODUCT EFFECTIVENESS** | **AGRICULTURAL CHEMICALS CONTROL TECHNICAL COMMITTEE REVIEWS REPORTS** | **CROP PROTECTION BOARD MAKES DECISION ON REGISTRATION** | **PRE-EXPORT VERIFICATION CERTIFICATE OF CONFORMITY (PVoC) OBTAINED TO IMPORT PRODUCT²** |

*Entire process takes 3 seasons (18 to 24 months) – to complete for a cost of ~US$300*

Source: (1) Interviews with Crop Inspection and Regulation Assistant Commissioner;
Notes: (2) PVoC is an international standard that issues a Certificate of Conformity to verify all regulated products are in fact what they claim to be.
Herbicides sold in Uganda are imported in a finished form

**Overview**

- All manufacturing is done abroad, there is no domestic chemical manufacturing
- Import comes in cartons with products ready for sale
- Only two companies are licensed to break-bulk and repackage
- Importers act as wholesalers as well
- Agro dealers purchase from importers or distributors
- Some agro dealers visit “village days”* to broaden their market reach into rural areas
- Mobile/rural retailers operate primarily in rural areas and do not own their own storefronts
- Major importers often sell directly to large-scale farms
- Smallholders purchase inputs from local agro-input dealers

**Key Players**

- Large majority of the available products are inexpensive herbicide manufactured in China (Kingtech Corp.) and India (Indofil Chemicals)
- None of the major manufacturers have dedicated presence in Uganda
- Major manufacturers distribute through 23 importers (17 CropLife members)
- The top three importers are Buukola, Nsanja and, Gen. Allied
- Bukoola and Gen. Allied are licensed to repackage
- CropLife Uganda is the major industry association for importers and suppliers
- There are ~2,600 agro dealers, ranging from very small independent retailers to larger distributors
- Only 1,300 of these dealers are registered through UNADA, the national agro dealer association
- Agro dealers are located in both rural and urban trade centers
- Sugar and tea estates account for much of the branded herbicide sales

* Explanation on next page
Counterfeiting within the herbicide sector in Uganda primarily occurs in one of three forms . . .

1. **Mislabeled / Sub-standard Product** that is imported into the country and flows through the supply chain; in such cases, the formulation on the label does not represent the actual formulation in the bottle (i.e. bottle says 41%, but it is actually ~30% concentrate); reduced concentration products do have some efficacy, but not to the extent one would expect based on the label.

2. **Package Reuse / Adulterated or Sub-standard Product** occurs at the agro-dealer level and takes one of two forms:
   1. **Label Reuse**: The herbicide sold is low-quality authentic herbicide, but the label is removed and a copy of a premium-brand’s label is printed and pasted on the herbicide bottle. This occurs in instances when there is high-demand for a premium brand.
   2. **Bottle Reuse**: Agro-dealers buy back used bottles from farmers for ~US$0.4 and refill them with diluted/fake material. About 85% of containers get reused.

3. **Label Imitation / Adulterated or Sub-standard Product** in which a replica brand/label is printed that has a slight variation of an authentic brand’s name (see appendix for example) and the product inside is sub-standard.

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**Estimate of breakdown of counterfeit herbicide market**

- **~60%** Importers
- **~20%** Mobile Salesmen
- **~20%** Smallholders
Drivers of Counterfeiting are interrelated and do not function in isolation.
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Maize accounts for ~60% of the volume sold on the formal Ugandan seed market, of which 60% are hybrid varieties.

% Breakdown of Maize Seed Market
- Formal Seed Market: 15%
- Informal Seed Market: 85%

% Breakdown of Certified Seed Market
- Foreign Hybrid: 45%
- OPV: 40%
- Local Hybrid: 15%

Price Range for 1 kg of Maize
- OPV: 0.8 USD
- Local Hybrid: 2.0 USD
- Foreign Hybrid: 3.0 USD

Leading Brands in the Hybrid Maize Sector
- The most well-known and respected seed companies are: Fica, East African Seed and NASECO. All these companies control quality and brand through their own production plots and packaging of their seeds.
- Brands influence purchase behavior as seed companies have well-known reputation.
- Certain foreign hybrid brands are also well known and sought out by farmers (Pannar, Dekale, etc.).
- Popular hybrid maize seed varieties include: Longe 9H, 10H and 11H, PAN 67, KH500 - 43A

Source: Joughin (2014), Expert interviews, Monitor Deloitte field research
Uganda’s seed laws and draft regulations include many international standards, but the capacity to enforce the enacted and proposed regulations is currently insufficient.

**Key Players**

**Parliamentary Committee on Agriculture** – Mandated to review and approve sector policies and strategies

**National Seed Certification Services (NSCS)** – Mandated to regulate quality assurance, monitor and enforce regulations including licensing of seed dealers, field crop inspection, sampling and laboratory testing, official certification, and the sealing of seed bags

**National Agricultural Research Organization (NARO)** – Responsible for the production of breeder and foundation/parent seed (main source of new crop varieties); coordinates public agriculture research and development

**National Agriculture Advisory Services (NAADS)** – Aims to empower farmers to access and utilize advisory services provided through extension network of contracted government workers

**Relevant Seed Regulations**

**Seed Act and Plant Act of 1996**: Requires all new varieties to be tested for two seasons before release and for all seed offered for sale to be properly labelled and sealed

**Seeds and Plant Act Regulations – Draft (2011)**: Regulatory framework to outline how seeds should be regulated (including certification, storage, multiplication, and testing)

**Plant Variety Protection Bill (2011)**: Suggested policy to grant plant breeders’ the rights to provide high quality seeds and planting materials to farmers – once enacted, it will spur investment in the seed sector

**Steps to License Seed Product and Company**

1. **Step 1**
   - Importer or manufacturer of seeds
   - Register product & company with NSCS

2. **Step 2**
   - NSCS evaluated seed variety through genetic testing

3. **Step 3**
   - Agriculture inspectors conduct field inspections

4. **Step 4**
   - If seed lot approved, seed company can begin harvesting, storing, etc.

5. **Step 5**
   - NSCS re-tests product to ensure quality before packaging

6. **Step 6**
   - NSCS provides official Ministry of Agriculture label and approves seeds for sale

*Entire process takes approximately 6 months – to complete for a cost of ~US$250*

Source: (1) Interviews conducted with NSCS Assistant Commissioner
Hybrid seeds originate from NARO or are imported from abroad; seed companies are involved in the multiplication process and distribute through various channels

**Key Players**
- Only a few companies have their own production and demo plots: Fica, East African Seed, NASECO
- Contract growers are selected based on capacity, tech capabilities, and skill to maintain seed quality
- High regarded seed companies are NASECO, East African Seed and Fica
- Uganda Seed Trade Association (USTA) has 23 registered members and serves as the industry association

**Overview**
- Majority of the seed companies use contract growers
- Hybrid parent seeds are imports or come from NARO
- On the formal seed market, hybrids account for the majority of seeds sold
- Seed companies use hundreds of contract growers around the country to meet demand
- Major seed companies have their own packaging equipment
- Majority of formal seed is sold though stockists and agro dealers from the container village (the major market center in Kampala)
- There is a significant demand from NGOs in order to donate to smallholder farmers
- Large scale farms buy seeds directly from seed companies
- Farmers trading seeds with each other drives the majority of the OPV market
- AGRA-PASS program buys seeds to educate farmers on achieving higher yields
- NAADS buys seeds for farmer education and training
- Mobile salesmen are often extensions of agro dealers to reach more rural markets
- The limited number of commercial farms account for the majority of the formal hybrid seed market
Mislabeled / Diluted Seed occurs in one of two ways:
1. Seed growers adding grains or OPVs to packages to “top-up” orders when they face constrained supply and cannot meet the contracted amount with genuine seed.
2. Mobile salesmen selling fake seed/grain out of the back of trucks along with genuine seeds when smallholder farmers cannot afford standard package sizes.

~50%

Label Imitation / Adulterated or Sub-standard Seed occurs at the agro-dealer level (large dealers/distributors). Imitation packages of leading seed companies are imported from overseas and filled with grain and/or fake seeds; traders create fake hybrid seeds by dyeing locally produced cereal grains before repackaging them.

~40%

Label Reuse / Adulterated Seed occurs when seed supply is constrained. Because farmers are brand-conscious, agro dealers acquire and re-use bags of reputable seed companies and refill them with grain and/or fake seeds.

~10%

Estimate of breakdown of counterfeit seed market
Drivers of counterfeit seed are interrelated and do not function in isolation.

<table>
<thead>
<tr>
<th>Drivers of Counterfeiting in Uganda’s Seed Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Package Integrity across Distribution Chain</strong></td>
</tr>
<tr>
<td><strong>High Level of Intermediation</strong> – The seed value chain is highly intermediated (as illustrated by the previous slides), which introduces a structural risk for the seed sector – the more times seeds change hands, the higher the risk. In addition, farmers often want smaller volumes than the supplied packages; this bulk breaking provides mobile salesmen an opportunity to dilute seeds.</td>
</tr>
<tr>
<td>“Bags go on bicycles, then from the bicycles to the bus, then from the bus to the retailer. This chain can be long…”</td>
</tr>
<tr>
<td><strong>2. Manufacturers Willingness to Intervene</strong></td>
</tr>
<tr>
<td><strong>Out-of-stocks of Brands During Planting Season</strong> – Brands with good reputations attract high demand, and in the case of a supply/demand mismatch, reputable brands will be the first ones to be faked or diluted. Many seed companies are also reluctant to invest in inspection of their product at the point of sale, which in turn leads to more counterfeit activities.</td>
</tr>
<tr>
<td>“Counterfeit products always pop-up during the planting season, when demand is high.”</td>
</tr>
<tr>
<td><strong>3. Smallholder Context/Behaviour</strong></td>
</tr>
<tr>
<td><strong>Identical Look of Grain and Seed</strong> – There is no noticeable visual difference between maize seed and grain. Without genetic testing, even seed experts cannot tell the difference between grain and genuine seed. It is only after germination, or a lack thereof, when the farmer realizes the quality of the seed. This lead-time enables opportunities to engage in counterfeiting.</td>
</tr>
<tr>
<td>“Traders load counterfeit seed and drive through rural districts distributing to uneducated agro dealers, who cannot tell the difference”</td>
</tr>
<tr>
<td><strong>4. Distribution Chain Actors’ Behaviour</strong></td>
</tr>
<tr>
<td><strong>Profit Potential of Selling Diluted Seeds</strong> – Contract grower yields are often unable to fulfill demand for seed in Uganda (given its relatively mature and growing seed sector); to fulfill their orders, growers may “top-up” seed packages with grains.</td>
</tr>
<tr>
<td>“If the contract says 50 tons, you will get 50 tons, but you might get 5 tons of grain in it.”</td>
</tr>
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Fertilizer usage in Uganda is one of the lowest in Africa, amounting to only ~50,000 tons of inorganic fertilizers sold; current market size is about US$ 51 million.

**Inorganic Fertilizer Market in Uganda**

- **NPK**: 65%
- **UREA**: 15%
- **DAP**: 15%
- **Other**: 5%

Total Market Size is 50k Tons (US$ 51M)

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**Price Range for 1 kg of Inorganic Fertilizer**

- **NPK**: 1.0 USD
- **UREA**: 1.0 USD
- **DAP**: 1.1 USD
- **Other**: 1.2 USD

**Sizes of Herbicide Packaging**

- Various smaller sizes: 1kg and 2kg and 5 kg bags (recent development)
- 50 KG: Industry standard (majority of product sold)

**Leading Brands in the Inorganic Fertilizer Sector**

- Fertilizers are generally not marketed as brands but by ingredients (NPK, DAP, UREA etc.)
- Export Trading Group (ETG) is the largest importer, their trade brand is “Falcon”
- Majority of fertilizer demand comes from sugar and tea estates or commercial farms
- Smallholder farmers buy very little fertilizer for staple crop production

Source: AMITSA Price Report (Dec, 2013), Expert interviews, Monitor Deloitte field research
Uganda’s current crop protection legal infrastructure covers fertilizer; separate fertilizer regulations to monitor organic, liquid fertilizer have been drafted but not been enacted

**Key Players*  

**CROP INSPECTION AND REGISTRATION DEPARTMENT (CIRD)** – Newly mandated department (2013) to license agro dealers and importers; assess and certify quality of agro-chemicals; monitor and enforce compliance of agro-chemical regulations in imports and exports

**CROP PROTECTION BOARD (CPB)** – In coordination with CIRD, approves registration of crop protection products and ago-dealers; the Agricultural Chemicals Control Technical Committee reports to and makes recommendations to CPB (see below for role of ACCTC)

**UGANDA NATIONAL BUREAU OF STANDARDS (UNBS)** – Mandated to enforce the use of standards across industries primarily at points of entry; UNBS is under the Ministry of Trade

**NATIONAL AGRICULTURE ADVISORY SERVICES (NAADS)** – Provides advisory services and subsidized inputs through network of government extension workers (e.g. training on safe pesticide use, subsidized herbicides in Northern Uganda)

*Note: Key players are similar to those for CPPs

**Relevant Fertilizer Regulations 1**

**FERTILIZER REGULATIONS (2011) - DRAFT**: Regulatory framework outlining how fertilizer, specifically, should be regulated; primarily focused on inorganic liquid fertilizers; proposed regulations are less strict than those for crop protection chemicals

**CONTROL OF AGRICULTURAL CHEMICALS ACT (2006)**: Requires any agro-chemical (including fertilizer) that is manufactured, stored, imported or distributed in Uganda to be registered, packaged and labeled in accordance with the law

**NATIONAL AGRICULTURE ADVISORY SERVICES ACT (2001)**: Mandates the provision of agricultural advisory services to improve farmer’s access to quality agricultural inputs; responsible for extension services across Uganda

**Steps to Become A Licensed Fertilizer Importer or Manufacturer1**

1. **IMPORTER OR MANUFACTURER OF FERTILIZER**
2. **REGISTER COMPANY WITH CIRD**
3. **AGRICULTURAL INSPECTOR VISITS PREMISE AND WRITES REPORT FOR TECHNICAL COMMITTEE**
4. **AGRICULTURAL CHEMICALS CONTROL TECHNICAL COMMITTEE REVIEWS REPORTS**
5. **CROP PROTECTION BOARD MAKES DECISION ON REGISTRATION**

All importers must be registered, but only inorganic, liquid fertilizer is required to be tested and registered

Entire process takes up to 6 months – to complete for a cost of ~US$ 80

Source: (1) Interviews conducted with Crop Inspection and Regulation Assistant Commissioner
Notes: (2) PVoC is an international standard that issues a Certificate of Conformity to verify all regulated products are in fact what they claim to be.
Fertilizer is imported into Uganda, through Kenya, and is primarily used on commercial farms

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Importers</th>
<th>Distributors</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overseas Manufacturers (~5-10)</td>
<td>Ugandan Importer/Wholesaler (~20-25)</td>
<td>NGOs</td>
<td>Agro Dealers/Stockists (~2,600)</td>
</tr>
<tr>
<td>Major manufacturers include Potash Corp. and Mosaic – the leading fertilizer manufacturers in the world</td>
<td>Importers source their product directly or through Kenyan/Tanzanian importers located in Mombasa and Dar es Salaam where bulk shipments arrive</td>
<td>Because fertilizer is imported in bulk, importers and wholesalers repackage it into smaller volumes before selling to agro-dealers</td>
<td>Over half of fertilizer consumption in Uganda comes from commercial farms</td>
</tr>
<tr>
<td>~5 major importers, 15 to 20 wholesalers</td>
<td>Significant informal trade exists through neighboring countries</td>
<td>Bulk breaking is done by all distributors selling to smallholders</td>
<td>Large farms source agricultural input products directly from the manufacturer or the importer</td>
</tr>
<tr>
<td>Export Trading Group (ETG) commands ~40% of the inorganic fertilizer market</td>
<td>NGOs source and distribute some fertilizer, largely for use on demo plots (USAID IDEA project)</td>
<td>~250-300 rural stockists</td>
<td>Major users are sugar and tea estates</td>
</tr>
</tbody>
</table>

- All fertilizer in Uganda is manufactured overseas; there is no domestic production
- Fertilizer is generally imported through waterways – Uganda is landlocked, there is no direct access to a port
- ~250-300 rural stockists
- Major users are sugar and tea estates
Counterfeiting within the fertilizer sector in Uganda primarily occurs in one of three forms . . .

**Overview**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>OVERSEAS MANUFACTURERS</strong></td>
<td><strong>KENYAN IMPORTERS</strong></td>
<td><strong>AGRO DEALERS/STOCKISTS</strong></td>
<td><strong>SMALLHOLDERS</strong></td>
</tr>
<tr>
<td></td>
<td><strong>UGANDAN IMPORTER/WHOLESALE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>MOBILE SALES MEN</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>LARGE FARMS</strong></td>
</tr>
</tbody>
</table>

**Mislabeled / Underweight Product** occurs when a large bag is opened, some fertilizer is removed, and then the bag is resealed; the label may say 50kg, but the contents in the bag are only 48kg. This is the most frequent form of counterfeiting.

*Note: Bulk Breaking*

**Mislabeled / Diluted Product** occurs after the product has been imported and flows through the distribution channels; agro-dealers will open the bags, remove some authentic fertilizer, and refill them with ash or other low value material.

*Note: Bulk Breaking*

**Mislabeled / Adulterated Product** occurs when agro-dealers or mobile salesmen break-up large bags (i.e. 50kg) and repackage them into smaller ones (i.e. 5kg) that are more affordable to smallholder farmers. In such instances, ash or low value material may also be added to fertilizer.

*Note: Bulk Breaking*

**Estimate of breakdown of counterfeit fertilizer market**

- **~50%**
- **~30%**
- **~20%**
Drivers of Counterfeiting in Uganda’s Herbicide Market

Drivers of counterfeiting are interrelated and do not function in isolation

1. **Package Integrity across Distribution Chain**
   - **Bulk Breaking Along Value Chain** – All import companies distribute 50kg bags (global industry standard). In Uganda, farmers cannot afford bulk packages, so agro-dealers and mobile salesmen have to break the packages into small packages in order to cater to farmer demand. During this bulk breaking process, adulterated/diluted product is easily introduced.

2. **Manufacturers Willingness to Intervene**
   - **Low Incentives to Supply Market** – Uganda’s usage of inorganic fertilizer is the lowest in East Africa. It is not profitable for manufacturers to supply smallholders because there is such limited demand for fertilizer (low volumes). Furthermore, those smallholders who do purchase fertilizer demand 1 kg, 2 kg or 5 kg bags – sizes that are the manufacturer does not produce.

3. **Smallholder Context/Behaviour**
   - **Lack of Product Knowledge** – Many farmers as well as agro-dealers do not have the product knowledge to distinguish between genuine and fake inorganic fertilizer. Counterfeit products (e.g., ash, sand, etc.) often look very similar to authentic fertilizer.

4. **Distribution Chain Actors’ Behaviour**
   - **Agro-Dealers Seek Higher Margins** – By the time the product arrives in Kampala from Nairobi, it has incurred numerous costs associated with transportation, storage and handling, and certification. In order for agro dealers to make more than a slim profit on the sale of fertilizer, they are incentivized to dilute the product (thus creating more volume to sell).

---

- Everywhere in the world you find 50kg fertilizer bags. You need at least that much for an acre, but in Uganda, farmers can’t afford a whole bag.”

- “If I tell my CEO that I need a couple extra thousand pounds of fertilizer, they just laugh at me. You can’t make much money in this market.”

- “Agro-dealers don’t know what they are selling - especially when it comes to fertilizer because it’s so seasonal and such a small part of their shop.”

- “The middle of the supply chain is long. Prices start at UGX 200 and become UGX 700 as the product changes hands.”
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  - Uganda: Overview & Existing Initiatives to Address Counterfeiting
  - Uganda: Herbicide
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  - Uganda: Inorganic Fertilizer
- **Assessment of Technological Environment in Ghana & Uganda**
  - Summary of Solutions
  - Assessment of Each Solution
  - Applicability of Solutions
  - Path Forward & Recommendation
In order for a counterfeiting solution to be effectively implemented, we assessed the technological environment of each country across the following dimensions

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Retailer familiarity with enabling tools</strong>: enabling tools may include hand-held scanners, POS systems, QR scanning, etc.; this factor is important given the training / education required to implement different types of technologies</td>
</tr>
<tr>
<td>2</td>
<td><strong>Smallholder familiarity with enabling tools</strong>: enabling tools may include coin scratch, QR scanning, holograms, hidden imaging, etc.; similar to above, this factor is important given potential training / education required to implement different types of technologies</td>
</tr>
<tr>
<td>3</td>
<td><strong>Analog Phone Penetration</strong>: this factor will be important for any technology that utilizes mobile authentication</td>
</tr>
<tr>
<td>4</td>
<td><strong>Smart Phone Penetration</strong>: smart phone applications can enable several authenticating / tracking functionalities, including: barcode scanning, QR scanning, inventory management, etc.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Radio Signal Strength</strong>: radio can be an effective communication medium to encourage technology adoption; also, signal strength is important for RFID tracking</td>
</tr>
<tr>
<td>6</td>
<td><strong>Internet / Data Connectivity</strong>: internet access and data services impact both the functionality and adoption of technologies with web-based components</td>
</tr>
<tr>
<td>7</td>
<td><strong>Reliable Power Connectivity</strong>: measure of both voltage consistency and power supply / uptime; this factor carries significance for both consumer-facing components (e.g., charging of mobile phones) as well as manufacturer/developer-facing mechanisms (e.g., data server uptime)</td>
</tr>
<tr>
<td>8</td>
<td><strong>Use of tracking technologies along supply chain</strong>: tracking technologies include: use of hand held scanners, system integration across supply chain, etc.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Local data storage providers</strong>: potential to impact feasibility and operation of technology if local regulations require data to be stored in-country</td>
</tr>
<tr>
<td>10</td>
<td><strong>Local manufacturers of enabling technologies</strong>: may include bar code generators, serialization providers, electronic tag manufacturers (e.g., RFID), etc.; availability of local manufacturers may impact costs of production</td>
</tr>
<tr>
<td>11</td>
<td><strong>Local maintenance services for enabling technologies</strong>: local maintenance services may include: hand held or PC repair, smart phone repair (for QR scanning), etc.; availability affects the ease of development / production and ongoing operation of the technology</td>
</tr>
</tbody>
</table>
In summary, Ghana and Uganda face similar technological challenges, although none are insurmountable for implementing a technological solution to counterfeiting.

### Technological Challenges Faced:

#### Ghana

1. **Limited Use of Technology Along Supply Chain** – Most actors along the supply chain record inventory manually by hand (especially at the distributor and agro dealer level); bar code scanners or other tools are not used to track-and-trace product.

2. **Retailer Use of Enabling Tools** – Use of electronic point of sale technologies such as bar-code scanners or QR scanners is limited among most retailers.

3. **Limited Smartphone Usage Among Smallholders** – The majority of smallholders have access to analog phones; however, the usage of smartphones is limited.

4. **Internet/Data Access is Poor in Rural Areas** – Internet/data access is quickly growing in major cities, but unreliable in rural areas.

#### Uganda

1. **Limited Use of Technology Along Supply Chain** – Most actors along the supply chain record inventory manually by hand (especially at the distributor and agro dealer level); bar code scanners or other tools are not used to track-and-trace product.

2. **Retailer Use of Enabling Tools** – Use of electronic point of sale technologies such as bar-code scanners or QR scanners is limited among most retailers.

3. **Limited Cell-Phone Penetration Among Smallholders** – Fairly low cell phone penetration in rural areas among smallholders.

4. **Internet/Data Access is Poor in Rural Areas** – Internet/data access is quickly growing in major cities, but unreliable in rural areas.

5. **Slow Adoption of New Technologies Among Smallholders** – Smallholders are reluctant to use new technologies; illiteracy is high.

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(1) While other challenges may exist, included in this analysis are those that are most relevant for implementing an anti-counterfeiting solution.

(2) World Bank reports ~50%; figure would need to be validated with field evidence before piloting an intervention that leverages mobile technology.
## Enabling Environment Assessment Result: Ghana

<table>
<thead>
<tr>
<th>Enabling Factor</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| Retailer familiarity with enabling tools | ![Low] | - Use of electronic point of sale technologies such as bar-code scanners or QR scanners is limited among most retailers  
  - However, the Market Information Platform for Agro-Dealers (MIPAD) application is currently being piloted among 24 agro-dealers, which is used to track inventory volume and prices with an Android phone  
  - Many agro-dealers own smart phones for personal use (especially in Urban areas) |
| Smallholder familiarity with enabling tools | ![Low] | - Smallholders are very familiar with coin scratch (due to using it to top up their mobiles), but exposure to other tools – such as QR scanning, holograms, or hidden images / security ink – is limited |
| Analog Phone Penetration | ![Low] | - There is 105% mobile penetration in Ghana (some individuals utilizing multiple phones)  
  - Analog phone penetration is also high in rural areas, but smallholder farmers mainly use these phones to make phone calls, as opposed to texting |
| Smart Phone Penetration | ![Low] | - Smart phone penetration is 18%, and concentrated in urban areas |
| Radio Signal Strength | ![High] | - Radio coverage is widely available, even in rural areas |
| Internet / Data Connectivity | ![Low] | - Internet penetration rates are currently ~17%; internet adoption is growing steadily in Accra and other major cities, but there is virtually no connection in many parts of rural Ghana  
  - While over 79% of the population in Ghana has GSM coverage, 3G service is only available in major cities |

Source: Expert interviews, World Bank Indicators; Mobile for Development Intelligence Statistics
## Enabling Environment Assessment Result: Ghana

<table>
<thead>
<tr>
<th>Enabling Factor</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable Power Connectivity</td>
<td></td>
<td>‣ Power consistency: Voltage fluctuations are common, and can present dangers to electronic equipment (e.g., cooling equipment for servers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‣ Power supply / uptime: Ghana has its own hydroelectric generation station so the supply of power is better than elsewhere in West Africa, but varies across regions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‣ In urban environments, power is supplied 95-98% of the time, but in rural areas the supply of power can be anywhere from 30% to 65%</td>
</tr>
<tr>
<td>Use of tracking technologies along supply chain</td>
<td></td>
<td>‣ Supply chain tracking technologies are rudimentary (paper and pencil) or non-existent past the importer; use of serialization is limited</td>
</tr>
<tr>
<td>Local data storage providers</td>
<td></td>
<td>‣ Local data storage providers are present, however, they can be unreliable due to unstable power (which is required to cool servers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‣ Technology companies often contract with overseas providers at similar prices</td>
</tr>
<tr>
<td>Local manufacturers of enabling technologies</td>
<td></td>
<td>‣ Local manufacturers exist for the manufacturing of basic parts (i.e., coin scratch labels, holograms), but not for more complex hardware (i.e. RFID)</td>
</tr>
<tr>
<td>Local maintenance services for enabling technologies</td>
<td></td>
<td>‣ Technicians are widely available for basic maintenance and repair, but some scarcity of skill for maintenance of highly complex hardware</td>
</tr>
</tbody>
</table>

Source: Expert interviews, World Bank Indicators
## Enabling Environment Assessment Result: Uganda

<table>
<thead>
<tr>
<th>Enabling Factor</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retailer familiarity with enabling tools</td>
<td>![Assessment Icon]</td>
<td>▪ Use of electronic point of sale technologies such as bar-code scanners or QR scanners is limited among most retailers</td>
</tr>
<tr>
<td>Smallholder familiarity with enabling tools</td>
<td>![Assessment Icon]</td>
<td>▪ Smallholders are very familiar with coin scratch (due to using it to top up their mobiles), but exposure to other tools – such as QR scanning, holograms, or hidden images / security ink – is limited</td>
</tr>
</tbody>
</table>
| Analog Phone Penetration                | ![Assessment Icon] | ▪ Mobile penetration is ~50% in Uganda  
▪ ~62% of all phones are feature phones  
▪ Penetration number is skewed for urban areas where some people have multiple cellular phones |
| Smart Phone Penetration                 | ![Assessment Icon] | ▪ Smart phone penetration is ~19%, and concentrated in urban areas.  
▪ ~38% of all phones are smartphones  
▪ Adoption is fast among young people |
| Radio Signal Strength                   | ![Assessment Icon] | ▪ Radio coverage is widely available and considered a very effective media vehicle                                                       |
| Internet / Data Connectivity            | ![Assessment Icon] | ▪ Internet penetration rates are currently ~15%, but has increased significantly in recent years  
▪ Internet access is stable and widely available in cities, but very poor in rural areas  
▪ Although 98% of the population in Ghana has GSM coverage, 3G service is only available in major cities (e.g., Kampala, Jinja, Mbarara, etc.) |

Source: Expert interviews, World Bank Indicators, IT News Africa, BuzzCity
## Enabling Environment Assessment Result: Uganda

<table>
<thead>
<tr>
<th>Enabling Factor</th>
<th>Assessment</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable Power Connectivity</td>
<td></td>
<td>- Power supply / uptime: There is 685MW of installed capacity in Uganda, coming from hydropower, providing ~40% coverage for urban and 6% coverage for rural areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- In urban environments, power is supplied more than 90% of the time, but in rural areas the consistent supply of power is poor</td>
</tr>
<tr>
<td>Use of tracking technologies along supply chain</td>
<td></td>
<td>- Supply chain tracking technologies are rudimentary (paper and pencil) or non existent past the importer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- During the e-verification pilot, retailers were competent with the SMS technology used for inventory tracking, but the sample was small and inputs to the system were not verified for accuracy</td>
</tr>
<tr>
<td>Local data storage providers</td>
<td></td>
<td>- Local data storage providers are unreliable and expensive; technology companies can contract reliable overseas suppliers for much cheaper</td>
</tr>
<tr>
<td>Local manufacturers of enabling technologies</td>
<td></td>
<td>- Local manufacturers exist for the manufacturing of some basic parts (i.e., holograms), but not for more complex ones (i.e. RFID, scratch-off labels)</td>
</tr>
<tr>
<td>Local maintenance services for enabling technologies</td>
<td></td>
<td>- Technicians are widely available for basic maintenance and repair, but there is a scarcity of skill for maintenance of highly complex hardware</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The Kamwookya area of Kampala has a high concentration of IT businesses</td>
</tr>
</tbody>
</table>

Source: Expert interviews, World Bank Indicators, IT News Africa, BuzzCity
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  - Uganda: Inorganic Fertilizer
- Assessment of Technological Environment in Ghana & Uganda
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  - Path Forward & Recommendation
Manufacturers have expressed interest in addressing this challenge as long as the cost of implementing a solution is less than the incremental profit earned.

**Illustrative Scenario**

A manufacturer of CPPs is considering an investment of $500,000 in an anti-counterfeiting solution. As a result of the solution, it expects to earn an additional $0.56 per bottle of CPP sold.¹

(1) Assume that CPP sells for $7, gross margin is 40%, and incremental revenue gain as a result of anti-counterfeiting solution is 20%

**Manufacturer Perspectives**

“Since counterfeit products are a problem for our consumers, they are a problem for us”

Anonymous

“The growth of counterfeit goods poses a serious problem for agrochemicals. Every year we invest 10% or more of our sales revenues in agricultural R&D, so that we can continue to offer safe solutions to our agricultural customers”

Anonymous

“Faced with the threat of counterfeiting, diversion and tampering, we’ve initiated a Global Anti-Counterfeit Program”

Anonymous

“We are working to combat counterfeiting of our products not only to protect our own competitiveness, but also on behalf of our customers, consumers and the environment”

Anonymous

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**MORE THAN 892,857 BOTTLES OF CPPs ARE SOLD IN THE TARGET MARKET**

900,000 bottles @ $0.56 profit per bottle > $500,000 Fixed Cost to Implement

**LESS THAN 892,857 BOTTLES OF CPPs ARE SOLD IN THE TARGET MARKET**

800,000 bottles @ $0.56 profit per bottle < $500,000 Fixed Cost to Implement
There are six solution archetypes that could address the challenge of counterfeiting; the primary focus of this engagement was on scalable technologies funded by manufacturers.

**Solution Archetypes to Address Counterfeiting**

1. **End-User Authentication**
   **Description:** End consumers verify that an agricultural input was produced by a credible, certified manufacturer; solution leverages either coin-scratch labels or holograms as the medium to conceal PIN code, and mobile phone (text or call) to authenticate source.
   - *Point Solution Evaluated: Coin Scratch & Mobile Authentication*

2. **Quality Assurance / Certified Channels**
   **Description:** The quality of the product is assured through independent testing, and actors along the value chain are certified to distribute the product; solution would require an external evaluator to test the product at each point of intermediation in the value chain.
   - *Point Solution Evaluated: Mobile Testing Kits*

3. **Smallholder Education**
   **Description:** Smallholder farmers are provided training platforms focused on the importance and value of genuine inputs, methods of detecting counterfeit products, and agricultural input purchasing best practices.
   - *Point Solution Evaluated: Information Collection & Dissemination Platform*

4. **Track-and-Trace Technologies**
   **Description:** Manufacturers verify the movement of an input at each point along the value chain; solution leverages either RFID tags (passive or active) or barcode applications (2D or QR codes).
   - *Point Solutions Evaluated: Barcode Applications, Inventory Management Platform, and RFID tags*

5. **Product, Package, or Channel Investment**
   **Description:** Manufacturers invest in direct access to the channel (e.g., build local import facilities and distribution centers); or invest in product innovation that is difficult to counterfeit (e.g., seed dyes) or invest in package innovation (e.g., smaller packs).
   - *Examples listed in appendix*

6. **Regulatory Investment**
   **Description:** Government regulatory agencies are equipped to set high quality standards for the manufacture and distribution of agricultural inputs, conduct random product testing, investigate sources of counterfeiting on an ongoing basis, and enforce regulations effectively.

Solutions related to end-user authentication, quality assurance / certified channels, track & trace technologies, and smallholder education were the primary focus of this research.
We have identified the key criteria that must be met in order for an anti-counterfeiting solution to be effective . . .

**Criteria for Optimal Anti-Counterfeiting Solution**

- **Effectively Addresses Causes of Counterfeiting** – Any solution must address the causes of counterfeiting – inefficient delivery channels, product stock-outs, smallholder farmer education, and ill-intentions of actors along the supply chain, etc.

- **Cost Effective** – In order for private sector actors to be incentivized to invest in an anti-counterfeiting solution, the cost to implement must be less than the incremental profit earned as a result of implementing the anti-counterfeiting solution (through increased willingness to pay, increased sales, etc.)

- **Delivers Improved Efficiency to Delivery Channels** – Counterfeiting is a symptom of a broader challenge in African agricultural input sectors – that is, inefficient delivery channels. Effective solutions will not only address counterfeiting, but also provide information/data to manufacturers on the consumer, channel, or overall market.

- **Leverages Innovative Technology** – Effective solutions will leverage technology to address the challenge (and will be less dependent on human intervention, where possible); in this regard, the solution can be more effectively scaled.

- **Limits Process Changes** – Effective solutions need to be implemented in the local context of African agricultural input sectors; the greater the process change required for actors in the value chain to implement the solution, the less likely they are to adopt and use the solution.

**BMGF could consider investing in a challenge prize contest to solicit innovative ideas that meet the criteria identified above**
and assessed six leading solutions that have been effective in other industries to tackle counterfeiting

<table>
<thead>
<tr>
<th>Description</th>
<th>Assessment of Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BARCODE APPLICATIONS</strong>&lt;br&gt;• Unique product information is encoded on barcodes, which are affixed to the product and scanned at each step of the value chain&lt;br&gt;• Manufactures are able to track product flow through value chain</td>
<td>• Requires significant process change; each actor needs to use scanners&lt;br&gt;• Expensive to implement</td>
</tr>
<tr>
<td><strong>MOBILE TESTING KITS</strong>&lt;br&gt;• Product is tested for quality at each stage of value chain by an external evaluator; agro dealers are independently certified to distribute agricultural inputs</td>
<td>• Requires significant investment in testing infrastructure and resources&lt;br&gt;• Addresses all types of counterfeiting</td>
</tr>
<tr>
<td><strong>COIN SCRATCH &amp; MOBILE AUTHENTICATION</strong>&lt;br&gt;• End consumers verify the product was produced by a credible, certified manufacturer (via coin-scratch labels &amp; SMS)&lt;br&gt;• Enables source authentication; eliminates bottle/label reuse</td>
<td>• Very effective solution when package integrity is maintained&lt;br&gt;• Low cost to implement and operate</td>
</tr>
<tr>
<td><strong>INFORMATION DISSEMINATION PLATFORM</strong>&lt;br&gt;• Farmer reports incidence of counterfeiting to hotline; data is aggregated and pushed back out to subscribers periodically&lt;br&gt;• Enables farmers to learn from each other – network effects</td>
<td>• Very effective to tackle counterfeiting when scale has been achieved&lt;br&gt;• Potential for garbage in, garbage out</td>
</tr>
<tr>
<td><strong>INVENTORY MANAGEMENT PLATFORM</strong>&lt;br&gt;• Agro dealers assess product inventory and notify manufacturers of stock levels through mobile application&lt;br&gt;• Primarily addresses root cause of counterfeiting: stock-outs</td>
<td>• Requires significant process change&lt;br&gt;• Addresses only one root cause of counterfeiting</td>
</tr>
<tr>
<td><strong>RFID TAGS</strong>&lt;br&gt;• Radio Frequency Identification (RFID) tag is affixed to product, crate, or pallet; RFID reader uses radio waves to wirelessly scan tag when product comes within close proximity</td>
<td>• Requires significant investment in RFID tags and RFID scanners&lt;br&gt;• Technology can be unreliable</td>
</tr>
</tbody>
</table>

Key:  
- End User Authentication  
- Track-and-Trace Technologies  
- Smallholder Education  
- Quality Assurance

(1) We identified other solutions as well; these are listed in the appendix
The solutions studied have different costs to implement; as a result, the quantity of input manufacturers would need to produce to break-even varies significantly

### Illustrative Gross Margin Per Unit of Herbicide Sold

<table>
<thead>
<tr>
<th>Income Statement Account</th>
<th>Today (No Solution)</th>
<th>Tomorrow (w/ Solution)</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$7.00</td>
<td>$8.40</td>
<td>Price of herbicide: $7.00 Incremental revenue as a result of solution: 20%¹</td>
</tr>
<tr>
<td>Gross Margin</td>
<td>$2.80</td>
<td>$3.36</td>
<td>Gross margin is 40% of revenue</td>
</tr>
</tbody>
</table>

**Incremental gross margin earned as a result of implementing anti-counterfeiting solution is $0.56**

### Quantity that Needs to be Produced/Sold for Manufacturer to Break-even

<table>
<thead>
<tr>
<th></th>
<th>Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Barcode Applications</td>
<td>665</td>
</tr>
<tr>
<td>Mobile Testing Kits*</td>
<td></td>
</tr>
<tr>
<td>Coin Scratch &amp; Mobile Authentication</td>
<td>415</td>
</tr>
<tr>
<td>Information Dissemination Platform*</td>
<td>1,110</td>
</tr>
<tr>
<td>Inventory Management Platform*</td>
<td>680</td>
</tr>
<tr>
<td>RFID Tags</td>
<td>17,845</td>
</tr>
</tbody>
</table>

(1) Pilot conducted by IFDC found that willingness to pay increased by 10-15%, and market share doubled, for products with counterfeit solution
(2) See detailed cost slides for more information on what is included in the costs; costs are based on estimate ranges (mid-point of costs is assumed above)
* Solution cost would likely be spread across a few manufacturers given the shared value achieved
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Barcode Applications: Solution Overview

Benefits of Solution to Delivery Channel

- **Reduces Prevalence of Counterfeits** – Scans can be used to track and read up to 2,000 bytes of data embedded in 2D bar codes to instantly verify genuine products and validate source of products.

- **Channel Data Collection** – Manufacturers gain information such as which retailers are moving the most product, what products and brands are demanded by end consumers, and which geographic locations use the most inputs; this information can be used for sales planning and channel investment decisions.

- **Inventory Management** – Manufacturers can maintain accurate information on the movement of products through the supply chain to track stock levels and re-allocate distributions as needed.

- **Improved Marketing Activities** – Data collected provides information on customer purchase behavior, including when customers purchase items, what brands they prefer in specific locations, and what their willingness to pay is; information can support sales planning and other marketing activities (e.g., customer segmentation).

---

1. **Serial numbers and/or other product-related ID info (e.g., batch numbers) are generated.**

2. **Information is stored in a secure database (either locally or abroad).**

3. **Data is encoded on barcodes, which are affixed to the product.**

4. **Product is scanned and leaves manufacturing facility.**

5. **Product arrives at importer/distributor and is scanned.**

6. **Product arrives at agro dealer and is scanned.**

7. **Farmer buys the product from the agro dealer.**
# Barcode Applications:
## Case Study – HP Global Protection Authentication Service for Ink Cartridges

### Using Barcodes to Reduce Counterfeit HP Ink Cartridges: Overview

- **Context** – HP’s Inkjet Printing and Solutions business sells millions of ink cartridges globally, and in recent years has seen an influx of counterfeit ink cartridges. HP’s unique numeric codes on holograms were not effective. “If you know what to look for, there’s great information in a hologram. But for consumers who don’t, they can be hard to read.”

- **Solution** – HP implemented a cloud based solution that uses encrypted, secure algorithms for mass serialization to generate unique codes for product labels. Customers can check goods at point of purchase using a smart phone scanner or SMS to instantly verify if a product is real.

- **Partners** – HP partnered with Brady Corporation, a provider of anti-counterfeit security labels to bring the solution in-house instead of using a 3rd party platform to generate codes.

- **Scale** – Solution is currently implemented globally across 5+ HP product lines; QR codes are printed on millions of products annually.

### Results

- After the pilot, HP expanded the authentication service to additional product lines.
- HP built trust and loyalty with consumers and was able to use the authentication app as an entry-point to communicating and marketing to their customers.
- “Every counterfeit that is identified turns into a selling opportunity for HP and the consumer gets the value they are paying for.”

### Lessons Learned

- Solution can provide additional benefits beyond authentication: the manufacturer can quickly pinpoint fraud for immediate action, collect valuable customer purchasing information, and communicate with customers.
- Cloud-based architecture makes the anti-counterfeiting solution fairly simple to operate and quick to implement.
- Unique numeric codes are the key to authentication; serialization process cannot be easily duplicated.

Source: (1) HP.com/go/authenticate
Barcode Applications: Implementation Assessment

**Success Factors**

1. **End-to-End Supply Chain Scanning**
   - Importers, distributors, and agro dealers must use barcode readers to ensure end-to-end validation; solution depends on each actor in the value chain scanning the product.

2. **Legible and Durable Labels**
   - Solution is ineffective if barcodes cannot be read by a scanner; therefore, investing in clear, durable labels that are not easily ripped, removed or soiled is critical.

3. **Training and Strong Communication**
   - To ensure smooth implementation, distributors and retailers need to be trained on how to use the scanner and why it is important to scan; also, to encourage buy-in and build a strong solution for the local environment, feedback needs to be solicited from distributors and retailers.

4. **Integrated Barcode and IT systems**
   - Barcode systems need to be integrated with a company’s information systems (including enterprise resource management tools) in order to conduct analytics on acquired data/information.

**Potential Barriers to Implement Solution**

1. **Expensive to Implement**: To provide true end-to-end supply chain validation and tracking, distributors, retailers and farmers would all require scanning devices (i.e. smartphones)
   - **Implication**: Invest in low cost scanning solutions for farmers and ensure distributors and retailers see the value in using the technology

2. **Process Change Required**: Most actors along the value chain are unfamiliar with scanning technology; current inventory management processes are rudimentary (paper and pencil)
   - **Implication**: Invest resources in training distributors, retailers and farmers on the importance of scanning and how to use the devices

3. **Easy to Replicate**: Barcode labels are relatively cheap and easy to print; dealers can reproduce or produce their own unique identifier labels
   - **Implication**: Invest in secure, encrypted mass serialization that can only be read by a scanner or scanning application approved by the manufacturer

4. **Label Integrity**: Solutions break down if scanners cannot read labels as a result of ripped, soiled or removed labels
   - **Implication**: Ensure barcodes are printed on labels directly during production process and not affixed afterwards
Barcode Applications:
Costs to Implement Solution

Cost Drivers¹
(Assumes 1.5M Labels)

- **Set-up Costs & Hardware**: $115-$155
  - One-time upfront fee for usage of barcode system (report creation, KPIs, analytics)²
  - Smartphones to dealers at ~$65 each (assumes 50% dealers need smartphones)

- **Variable Costs**: $105-$175
  - Assuming 1.5 M labels/year, cost per label = ~$0.02
  - Authentications incur charges per SMS ~$0.02, (90% authentication rate and of those 50% use SMS instead of scanner due to lack of internet/3G )
  - SMS monthly short code subscription is approx. $750/MNO

- **Training**: $55-$85
  - Workshops for agro dealers averages $20 per person³ (assumes all agro dealers are trained – Ghana used as proxy (n=3500))

- **Promotional Expenses**: $35-$85
  - Incentive for agro dealer to scan products; for each authentication, user receives one SMS credit

- **Total**: $310-$500
  - Represents total annual costs – variable costs, training, and other promotional expenses are recurring

Note: Costs are approximate

(1) Based on interview with technology service provider
(2) Based on similar set-up costs for coin scratch & mobile authentication
(3) Varies based on market; analysis based on Kenyan market
Barcode Applications: Players Required to Implement Solution

<table>
<thead>
<tr>
<th>Player</th>
<th>Role in Implementation</th>
<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| MANUFACTURERS                 | ▪ Use mass serialization and printers to incorporate unique barcode on each packaged product  
▪ Build and manage distributor relationships  
▪ Link technology with enterprise resource management software to track products  
▪ Use data collected to improve inventory management and marketing activities | Low (1/4)                  | High (4/4)              | Manufacturers may be unwilling to participate given cost of implementation (barcode scanners, and training requirements)  
▪ In Ghana, seed companies may be unable to participate given they don’t own the package printing process |
| DISTRIBUTORS/AGRO DEALERS     | ▪ Implement barcode application technology; scan products  
▪ Read data on barcodes to track and validate products | Low (1/4)                  | High (4/4)              | May be unwilling to participate given process change required; current tracking is rudimentary; players would require significant technical know-how  
▪ A degree of technical know-how will be required to use the scanner |
| FARMERS                       | ▪ Understand importance of barcode and consistently authenticate via SMS at POS | High (4/4)                 | Low (1/4)               | Marketing and education initiatives are required to convince farmers of value derived from authenticating                                           |
| TECHNOLOGY SERVICE PROVIDERS  | ▪ Use algorithms to develop secure, unique identifiers  
▪ Print barcodes on packages | High (4/4)                  | Low (1/4)               | There are a number of tech. providers that could offer solution (in-country and abroad)  
▪ A few local start-ups have mass serialization capabilities |
## Barcode Applications:
### Road Map

### Steps to Implement a Barcode Application Solution

<table>
<thead>
<tr>
<th>Step</th>
<th>Duration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-3 weeks</td>
<td>Identify target market and value chain</td>
</tr>
<tr>
<td>2</td>
<td>2-4 weeks</td>
<td>Identify stakeholders critical to solution’s success</td>
</tr>
<tr>
<td>3</td>
<td>6-10 weeks</td>
<td>Determine process flow of where and what items will be scanned</td>
</tr>
<tr>
<td>4</td>
<td>12-16 weeks</td>
<td>Identify key risks and develop mitigation strategies</td>
</tr>
<tr>
<td>5</td>
<td>Ongoing</td>
<td>Launch small-scale study to test viability</td>
</tr>
<tr>
<td>6</td>
<td>Ongoing</td>
<td>Print barcodes on additional packages</td>
</tr>
</tbody>
</table>

### Implementation of a barcode solution will require approximately 6-8 months
Mobile Testing Kits: Solution Overview

**Solution Overview**

0. Optimal product specifications (i.e., active ingredient) are acquired from regulatory body and stored in database

1. Product leaves manufacturer and is shipped using certified channels

2. Product arrives at certified importer/distributor and undergoes quality assurance testing

3. Product arrives at certified agro dealer and undergoes quality assurance testing

4. Farmer buys the product from certified source

5. Authentic product details are disseminated to those conducting tests

**Benefits of Solution to Delivery Channel**

1. **Counterfeit Detection** – Captures specific sources of counterfeit products in the value chain, which creates increased transparency across the whole chain; manufacturers can use the information to deploy inspectors to the area (or inform regulators)

2. **Data Collection** – Manufacturers are able to collect data on product quality across the value chain which may give insight if product was improperly handled, methods of counterfeiting (what ingredients were used to adulterate), etc.

3. **Improved Channel Investment** – Detailed product quality data will enable manufacturers to make better channel investment decisions and improve delivery channel capabilities (e.g., targeted promotion/pricing incentives)

4. **Brand Loyalty** – Quality testing across the value chain will result in a consistent customer experience and help manufacturers build brand loyalty
Mobile Testing Kits:
Case Study – Global Pharma Health Fund (GPHF) and Merck Fight Counterfeit Drugs

Merck/GPHF Mobile Lab: Overview

- **Context** – Developing countries are heavily affected by counterfeit medicines. These same countries often lack facilities to conduct effective medicine testing. Merck has funded a charitable organization that is now dedicated to fight counterfeit medicine across the world.

- **Solution** – The GPHF Minilab is a mobile mini-laboratory for instant drug verification. The toolbox has been specifically designed for use in developing countries and hard to reach areas. These kits can test for 70 different drug compounds. The tool is used by both governments to test products on the market as well as retailers to verify their supply.

- **Partners** – Merck funds GPHF’s activities including mobile labs with support from the German Agency for International Cooperation. Promoters and project partners are major NGOs from the US such as Management Sciences for Health (MSH) and the Promoting the Quality of Medicines program of the United States Pharmacopeia (USP PQM).

- **Scale** – There are 600+ mobile labs used in over 80 countries (over half of them in Africa).

Results

- Program resulted in identification and seizures of large shipments of counterfeit drugs in Madagascar, Senegal, Ghana, and Uganda.
- In Madagascar, 1600 tests of samples resulted in 2 pharmacy closures, 3 essential drug recalls, and 16 shipment seizures.
- The Tanzania Food & Drug Authority has adopted the GPHF-Minilab as its first-line testing defense to detect poorly produced and phony drug products.

Lessons Learned

- For comprehensive protection of the value chain, mobile testing kits must be complemented by full-fledged drug quality control laboratories – this will enable inspectors to test for more chemical compounds than the mobile kit allows.
- A large opportunity lies in aggregating the data that pharmacists and governments acquire through testing (e.g., manufacturers could assess types of counterfeiting that are occurring, what products are being adulterated, etc.).

Source: Global Health Pharma Fund Minilab
# Mobile Testing Kits: Implementation Assessment

## Success Factors

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Manufacturer R&amp;D Investments</strong>&lt;br&gt;Manufactures need to collectively increase their commitment to delivery channels and invest in both labor and capital into the new quality assurance process; furthermore, investment in R&amp;D to develop mobile quality testing kits for crop protection products is required.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Human Capital</strong>&lt;br&gt;Maintaining the various forms of quality assurance technologies will require numerous well-trained scientists and technicians.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Capacity Building</strong>&lt;br&gt;The government needs to play an important role in market-surveillance activities to ensure standards are enforced and counterfeit activity is properly punished.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Strategic Partnerships</strong>&lt;br&gt;Given that the benefits of the solution are shared, manufacturers will need to work together to align on a common quality assurance standard/process and collectively invest in the solution.</td>
</tr>
</tbody>
</table>

## Potential Barriers to Implement Solution

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Significant Process Change</strong>: Each step of the value chain will need to participate in testing processes that they do not currently conduct today&lt;br&gt;<strong>Implication</strong>: Training of each actor along the value chain on usage of testing technology, best practices, etc. is needed</td>
</tr>
<tr>
<td>2</td>
<td><strong>Implementation Complexity</strong>: Full-scale implementation requires coordination across several stakeholders within the value chain&lt;br&gt;<strong>Implication</strong>: Strong project management will be required during the pilot and roll-out phases</td>
</tr>
<tr>
<td>3</td>
<td><strong>Lack of Human Capital</strong>: There is a lack of well-trained scientists, technicians and agro-economists in Africa&lt;br&gt;<strong>Implication</strong>: There is a need to develop a strong pipeline of qualified technicians through partnerships between universities, manufacturers, and industry associations</td>
</tr>
<tr>
<td>4</td>
<td><strong>Regulatory Environment</strong>: There is currently no enforcement mechanism to act on the results of quality assurance testing&lt;br&gt;<strong>Implication</strong>: Capacity building will be required to increase government enforcement capabilities</td>
</tr>
</tbody>
</table>
Mobile Testing Kits: Costs to Implement Solution\(^1\)

Cost Drivers
(Assumes Testing for 10% of Ghana’s Herbicide Market)

- **Research & Development**: $500-$620
  - R&D to develop a new mobile testing device specific to crop protection chemicals; ~$560K (based on benchmark for similar investments in pharmaceuticals)

- **Hardware & Software**: $225-$280
  - Hardware costs of $5.5K per mobile kit (based on mobile kits used in pharmaceuticals); 35 kits purchased (to serve 10% of herbicide market)
  - Software development of ~$60K for database system

- **Operating Costs**: $160-$260
  - Includes personnel costs to operate kits, management/overhead, and on-going maintenance

- **Training**: $5-$10
  - 3-day workshop to train technicians to use equipment and input data into database ~$70 per trainee per day

- **Total**: $890-$1170
  - Represents total costs to implement solution (all costs are recurring, except R&D investment)

Note: (1) Costs are approximate

Note: Costs are based on technologies in the pharmaceutical industry, which will likely be different when applied to agriculture.
# Mobile Testing Kits: Players Required to Implement Solution

<table>
<thead>
<tr>
<th>Player</th>
<th>Role in Implementation</th>
<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturers</strong></td>
<td>- Collectively provide project funding and sponsorship</td>
<td></td>
<td></td>
<td>Manufacturers may be unwilling to invest due to implementation expense, and lack of regulatory resources to act on findings from quality testing</td>
</tr>
<tr>
<td></td>
<td>- Use data collected to target investments in delivery channels</td>
<td></td>
<td></td>
<td>Solution can be managed by an external evaluator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td><strong>Farmers</strong></td>
<td>- Limited role in implementation; farmers should only buy from certified channels</td>
<td>Low</td>
<td>High</td>
<td>Ability to participate depends on farmer's access to certified agro dealers (i.e. short distance to dealer) and thus access to quality-assured products</td>
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<tr>
<td><strong>Solution Provider</strong></td>
<td>- Supply portable testing kits</td>
<td>Low</td>
<td>High</td>
<td>There is strong willingness to provide labs in other industries such as pharmaceuticals: Ghana has 24 GPHF minilabs already deployed (3rd highest in Africa) and Uganda has 10 GPHF minilabs deployed</td>
</tr>
<tr>
<td></td>
<td>- Develop and deploy group of technicians capable to test products</td>
<td></td>
<td></td>
<td>Currently there are no agriculture specific mobile testing kit providers; technicians will need to be trained to provide services</td>
</tr>
<tr>
<td></td>
<td>- Provide maintenance services</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Upload data collected to a database for manufacturers to review</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td><strong>Industry Associations</strong></td>
<td>- Raise awareness about available technology and its benefits to members</td>
<td>Low</td>
<td>High</td>
<td>Industry associations are willing to partner when beneficial services are provided to their members</td>
</tr>
<tr>
<td></td>
<td>- Assist in organizing training sessions to encourage adoption</td>
<td></td>
<td></td>
<td>When funding is provided, associations have the ability to effectively reach their members for training purposes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td><strong>Importers and Agro Dealers</strong></td>
<td>- Opt-in to testing processes conducted by external evaluator</td>
<td>Low</td>
<td>High</td>
<td>May be unwilling to participate given agro dealers are often involved in counterfeiting activities</td>
</tr>
<tr>
<td></td>
<td>- Become certified channel member</td>
<td></td>
<td></td>
<td>Some agro dealers are in remote, rural locations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td><strong>Regulatory Agencies</strong></td>
<td>- Deploy regulatory personnel/inspectors to locations where counterfeits have been detected</td>
<td>Low</td>
<td>High</td>
<td>Regulators are under-resourced and would be willing to participate in solution that assists them</td>
</tr>
<tr>
<td></td>
<td>- Provide effective enforcement based on information submitted by external evaluator</td>
<td></td>
<td></td>
<td>Regulatory systems in Ghana and Uganda lack resources for enforcement and have limited technological capabilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>
Mobile Testing Kits:
Road Map

Steps to Implement a Mobile Testing Kit Solution

1. **Target Market and Scale**
   - Identify target value chain and market for the mobile testing kit program

2. **Device Development**
   - Partner with an input manufacturer to co-sponsor initiative
   - Identify a R&D partner with which to develop devices
   - Design and manufacture a low-cost mobile testing kit for target value chain

3. **Constituent Engagement**
   - Configure certified channel program
   - Map distribution network
   - Engage, train, and register certified dealers

4. **Small-Scale POC**
   - Launch small-scale study to test viability
   - Identify lessons learned for broader roll-out

5. **Large-Scale Rollout**
   - Engage and train additional distributors in order to scale certified channel
   - Roll out mobile testing kit program across target markets

6. **Ongoing Support**
   - Support solution adoption through ongoing marketing and promotion efforts, education programs, and stakeholder management initiatives

Implementation of a mobile testing kit solution will require approximately 7-9 months
Coin Scratch & Mobile Authentication
Coin Scratch & Mobile Authentication: Solution Overview

**Solution Overview**

1. **Unique PIN is generated using Digital Mass Serialization Technology**: A unique PIN is generated using digital mass serialization technology.

2. **PINS ARE STORED IN SECURE DATABASE (EITHER LOCALLY OR ABROAD)**: The PINS are stored in a secure database either locally or abroad.

3. **Codes are printed and labeled on each individual package**: Codes are printed and labeled on each individual package.

4. **Product is shipped through the supply chain**: The product is shipped through the supply chain.

5. **Product arrives at Agro dealer, who scans or texts in retailer code to validate product**: The product arrives at the Agro dealer, who scans or texts in the retailer code to validate the product.

6. **Farmer buys the product from the Agro dealer**: The farmer buys the product from the Agro dealer.

7. **Farmer scratches code/views hologram & texts PIN to validate product**: The farmer scratches the code, views the hologram, and texts the PIN to validate the product.

**Benefits of Solution to Delivery Channel**

- **Sales Data Collection**: Captures market data on purchasing locations, product types sold, and brands preferences, which can be harnessed to adapt and customize sales strategies.

- **Inventory Management**: Serialization and mobile authentication process enables the manufacturer to better track inventory movement, thus informing demand forecasts and supply chain management systems.

- **Direct Channel to Consumer**: Manufacturers gain access to consumers’ phone numbers, enabling them to send direct messages to consumers for targeted marketing campaigns, surveys, or promotional initiatives.

- **Brand Protection**: Reduces reputation risk which could be caused by the adulteration or imitation of branded products.

(1) Process of generating unique serial codes through random, pseudo-random, or sequential manner; Digital Mass Encryption (DME) could also be leveraged.
Coin Scratch & Mobile Authentication:
Case Study - BIOFEM and Sproxil Partnership in Nigeria

BIOFEM and Sproxil: Overview

- **Context** - Nigeria-based drug distributor BIOFEM Pharmaceuticals had been searching for a solution to address massive counterfeiting of its flagship Merck Soreno product for Type 2 Diabetes, Glucophage

- **Solution** – Sproxil’s scratch codes were affixed to over one million sachets of Glucophage, and the mobile verification application was piloted between February and May 2010

- **Partners** – BIOFEM worked with Sproxil to develop and implement the solution. In addition, Nigeria’s National Agency for Food and Drug Administration and Control (NAFDAC) was closely involved

- **Scale** – The 100-day pilot was launched in three of Nigeria’s major cities: Lagos, Abuja and Port Harcourt

Results

- Glucophage sales increased by more than 10 percent in Nigeria

- After the pilot, NAFDAC launched the first nationwide mobile-authentication service, and 40 manufacturers have signed on to use the technology thus far

- Some pharmacies were co-selling genuine and fake Glucophage in a box; BIOFEM discovered this and stopped the practice at some retail locations

Lessons Learned

- If accompanied by appropriate market education and promotion efforts, presence of coin scratch label can drive increased sales

- National regulatory agencies were also invested in the technology, strengthening the success of the program
### Potential Barriers to Implement Solution

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Description</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Package Integrity: In bulk input value chains, the product may not reach the consumer in the same package that it left the manufacturing facility</td>
<td>Mobile authentication may not be applicable to certain value chains without accompanying packaging innovations</td>
</tr>
<tr>
<td>2</td>
<td>Illiteracy: Illiteracy prevents some farmers from reading usage instructions and SMS replies</td>
<td>Pictorial-based instructions coupled with training on distinguishing between types of SMS replies may be necessary to ensure technology usage/ adoption</td>
</tr>
<tr>
<td>3</td>
<td>Regulatory Environment: Without proper standards and enforcement, low quality products can mimic the technology</td>
<td>Effectiveness of solution is strengthened by partnering with national regulatory agencies</td>
</tr>
<tr>
<td>4</td>
<td>Assumption of Risk: Recourses for counterfeit purchases are unclear; agro dealers may be hesitant to adopt the technology if they bear the risk for products which return invalid verifications</td>
<td>Important to ensure that appropriate mechanisms are in place for reimbursement of counterfeit products</td>
</tr>
<tr>
<td>5</td>
<td>Upfront SMS Cost: In some end-user verification pilots, farmers infrequently verified the product due to lack of air-time; sophisticated counterfeiters can take advantage of these users</td>
<td>Necessary to work with mobile networks to ensure that the SMS carries no charge to the consumer, as is the case with SMS short codes</td>
</tr>
</tbody>
</table>

### Success Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Effective Education and Promotion</td>
</tr>
<tr>
<td>2</td>
<td>Public-Private Collaboration</td>
</tr>
<tr>
<td>3</td>
<td>Strategic ICT Partnerships</td>
</tr>
<tr>
<td>4</td>
<td>Strong Mobile Phone Culture</td>
</tr>
</tbody>
</table>
## Cost Drivers

### (Assumes 1.5M Labels)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set-Up Costs</td>
<td>$10-$30</td>
<td>One-time upfront fee for usage of mobile authentication system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consistent across projects regardless of volume.</td>
</tr>
<tr>
<td>Variable Costs</td>
<td>$105-$195</td>
<td>Assuming 1.5 M labels/year, cost per label = ~$0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Includes code generation, label printing, call center operation, SMS,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and system support.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost is volume-dependent; &lt;100K units costs ~$0.50/label, while</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 M units/year costs ~$0.05/label</td>
</tr>
<tr>
<td>Market Education</td>
<td>$110-$170</td>
<td>Radio placement ad throughout year costs ~$90K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Workshops for agro dealers and farmers averages $10 per person^2 (assumes that 4000 farmers and 1000 agro-dealers are trained)</td>
</tr>
<tr>
<td>Other Promotional Expenses</td>
<td>$25-$35</td>
<td>May include incentives for authentication (e.g., added airtime), posters and informational materials, and other promotional expenses</td>
</tr>
<tr>
<td>Total</td>
<td>$250-$430</td>
<td>Represents total annual costs – variable costs, market education, and other promotional expenses are recurring</td>
</tr>
</tbody>
</table>

### Notes:

1. Based on interview with technology service provider
2. Varies based on market; analysis based on Kenyan market

Note: Costs are approximate
# Coin Scratch & Mobile Authentication: Players Required to Implement Solution

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<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturers</strong></td>
<td>- Act as initiative sponsors&lt;br&gt;- Provide funding for pilot and scale-up</td>
<td>Low</td>
<td>Low</td>
<td>Given low upfront investment and potential to drive sales, manufacturers will likely be open to solution adoption.</td>
</tr>
<tr>
<td><strong>Farmers</strong></td>
<td>- Understand importance of scratch label and consistently authenticate via SMS at POS</td>
<td>Low</td>
<td>Low</td>
<td>Marketing and education initiatives are required to convince farmers of value derived from premium products with scratch labels, and to ensure proper usage.</td>
</tr>
<tr>
<td><strong>Technology Service Provider</strong></td>
<td>- Develop data platform and operational infrastructure&lt;br&gt;- Generate codes (unique pins) and labels&lt;br&gt;- Provide IT and consumer support&lt;br&gt;- Work with MNOs to generate short-codes</td>
<td>High</td>
<td>High</td>
<td>A number of technology providers offer readily available, end-to-end solutions for coin scratch &amp; mobile authentication.</td>
</tr>
<tr>
<td><strong>Mobile Networks</strong></td>
<td>- Ensure reliable and consistent transfer of SMS communications at no cost to consumer</td>
<td>High</td>
<td>High</td>
<td>While establishing a short-code can be time-intensive, some technology providers already have relationships with MNOs.</td>
</tr>
<tr>
<td><strong>Regulatory Agencies</strong></td>
<td>- Provide effective enforcement of quality standards to mitigate risk of producers of low quality products mimicking technology</td>
<td>Low</td>
<td>Low</td>
<td>Solution provides valuable information on counterfeit activities, so regulators likely to be open to participation.</td>
</tr>
<tr>
<td><strong>Agro Dealers</strong></td>
<td>- Educate consumer on implications of product carrying a scratch label, and ensure proper mobile authentication usage</td>
<td>Low</td>
<td>Low</td>
<td>However, lack of resources may impede ability to prosecute offenders.</td>
</tr>
</tbody>
</table>
Coin Scratch & Mobile Authentication: Road Map

Steps to Implement a Coin Scratch & Mobile Authentication Solution

1. Target Market and Scale
   - Identify target geographic markets and value chains

2. Constituent Engagement
   - Develop partnerships with input manufacturers, regulatory bodies, and other development organizations if applicable
   - Identify appropriate technology service provider to engage with

3. Initiative Configuration
   - Establish strategic objectives, and develop supporting tactical plan for implementation
   - Understand key risks and develop mitigation strategies

4. Small-Scale POC
   - Launch small-scale study to test viability
   - Identify lessons learned for broader roll-out strategy

5. Broader Roll-Out
   - Roll-out solution across target markets

6. Ongoing Support
   - Support solution adoption through ongoing marketing and promotion efforts, education programs, and stakeholder management initiatives

Implementation of a coin scratch & mobile authentication solution will require approximately 5-7 months
Information Collection and Dissemination Platform
Information Collection and Dissemination Platform: Solution Overview

**Benefits of Solution to Delivery Channel**

- **Counterfeit Activity Data Collection** – By aggregating detailed information on the types and sources of counterfeit activity, manufacturers can harness data to inform predictive models on the distributors, products, and regions most susceptible to counterfeiting, and adapt strategy accordingly.

- **Market Strengthening** – Identification of specific sources of counterfeiting generates actionable insights that can be leveraged by manufacturers to inform choice of distribution partners, and by regulatory bodies to support enforcement initiatives. In this way, the quality of players along the value chain as a whole is improved.

- **Demand Forecasting** – By capturing region-specific statistics on attempted purchases of authentic brands, manufacturers are able to better understand true product demand at a local market level.

- **New Marketing Channel** – Manufacturers gain access to consumer phone numbers that can be leveraged for marketing purposes.

- **Market Building** – By providing a platform for word-of-mouth communication, farmers obtain information from a source that they trust (other farmers). This increased transparency may inspire greater smallholder confidence in the sector, thus driving increased demand.

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*Trends can mean simple thresholds, like 10 calls received about a certain product and/or agro dealer, or more sophisticated analysis like counterfeit products detected in a defined region within a certain timeframe.*
Information Collection and Dissemination Platform:  
Case Study – National Farmers Information Service (NAFIS) in Kenya

Note: This case study is not a direct solution to combat counterfeiting, but the technology would be very similar if it was applied and implemented as an anti-counterfeiting solution

### NAFIS in Kenya: Overview

- **Context** – Farmers could significantly improve their yields if information from extension officers was readily available to them; however, extension workers in Kenya are not able to reach all smallholders due to logistical, transportation, and administrative constraints. As a result, less than 50% of farmers receive information from extension officers.

- **Solution** – NAFIS uses an Interactive Voice Response (IVR) system to disseminate information to farmers. This system provides an automated voice system to navigate menus, enabling illiterate farmers to gain desired information (market prices, crops, weather, etc.). Information is gathered and uploaded by extension officers via a web platform; this is converted into voice using text-to-speech (TTS) technology and made available to farmers via the IVR system.

- **Partners** – Kenya Ministry of Agriculture and Kenyan Digital Network (KDN)

- **Scale** – Reached 2.1 million farmers (~46% of farmers), with estimated 10,000 users per day

### Results

- Over 10,000 users of the platform per day
- Applying advanced technologies (IVR and TTS) resulted in real-time information processing capabilities, enabling fast and reliable accessibility to information of market data and agriculture best-practices
- Enabled government to build legitimacy and increase trust with farmers

### Lessons Learned

- Farmers will trust the information dissemination system if information is authenticated by a reputable source (in this case, the Ministry of Agriculture)
- Providing a free mechanism to access the information through internet-based phones in village centers accelerated adoption
Information Collection and Dissemination Platform: Implementation Assessment

**Success Factors**

1. **Rapid Scaling**
   This solution relies heavily on network effects: the more farmers using the platform and the more frequently they participate, the more benefits the entire network will experience. It is thus critical to ramp up the number of users early-on to ensure scale is achieved.

2. **User Sensitization & Promotion**
   Farmers will need to be aware of this initiative and its benefits – this can be accomplished through radio programs, marketing materials, and smallholder trainings. In addition, farmers also need to be trained on how to properly identify counterfeit agricultural inputs.

3. **Adoption/Usage**
   In order for the information on the platform to be valuable and up-to-date, smallholder farmers need to frequently use the system by regularly reporting instances in which counterfeit inputs were purchased.

**Potential Barriers to Implement Solution**

1. **Influence of Exogenous Factors**: Farmers may mistakenly report a product as “counterfeit” if they experience low yields, which could be the result of other factors such as incorrect application or weather.
   **Implication**: Call center agents should ask validating questions in order to test reports. In addition, the system may need an external proof (i.e. certified channels/quality assurance) to validate quality of reported information.

2. **Rate of Adoption**: The system needs a critical mass of users in order for the solution to be effective.
   **Implication**: Leveraging existing groups (such as extension networks) early-on will help jump start the program and ensure wider adoption.

3. **Information Time-Lag**: There is a time-lag between purchasing the product, using the product, observing its efficacy, and reporting information.
   **Implication**: Maintaining a historical database and sharing results from previous seasons can provide valuable data for current purchases.

4. **Mobile Agro dealers**: Rural areas are often served by mobile agro dealers; thus, reporting information on them will be difficult.
   **Implication**: In rural areas, it will be more important to report on counterfeit products as opposed to which retailers deal them.

5. **Cost**: System may be expensive to scale; more farmers using the technology requires more call center agents.
   **Implication**: Will require collaborative financing given that benefits are shared across all manufacturers.
Information Collection and Dissemination Platform: Costs to Implement Solution

Cost Drivers¹
(Assumes ~65,000 farmers use service²; ~250 reports made daily³)

<table>
<thead>
<tr>
<th>USD (K)</th>
<th>Software</th>
<th>Infrastructure and Labor</th>
<th>Telecom</th>
<th>Market Education</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$80-$100</td>
<td>$195-$250</td>
<td>$105-$190</td>
<td></td>
<td>$510-$720</td>
</tr>
</tbody>
</table>

- Call center routing software and equipment costs $30K - $40K
- Basic CRM platform (i.e. 10 questions from every caller) to capture and analyze reported information is $50K-$60K

- Monthly wages are $300-$500 per agent; 7 agents are employed annually
- Infrastructure (rent, equipment, etc.) costs range between $2,000-$2,500 per seat per month

- Monthly ISDN line subscription is ~$750 per MNO (assumes four MNOs)
- Monthly fee for connection between call center and MNO (short-code) is $500-$1000/line per MNO
- Calling cost is 4 to 8 cents per minute (~250 calls daily, each call is ~5 minutes)
- SMS blasts are 1 to 2.5 cents per SMS; blast is sent weekly

- Radio placement ad throughout year costs ~$90K⁴
- Workshops for farmers averages $10 per person; ~6,500 farmers (10% of farmers using service) go through training

- Represents total costs incurred in the first year – infrastructure and labor, market education, and telecom costs are recurring

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¹ Based on interviews with technology service providers
² Methodology: Ghana herbicide market (valued at $45M) used as a proxy; given 17% of smallholders buy herbicide twice per year, and 30% of herbicide products are counterfeit, ~164K farmers purchase counterfeit herbicide annually. 40% of these farmers subscribe to service.
³ Assumes each farmer using service makes one report per year
⁴ Varies based on market; analysis based on Kenyan market

Note: Costs are approximate
Information Collection and Dissemination Platform: Players Required to Implement Solution

<table>
<thead>
<tr>
<th>Player</th>
<th>Role in Implementation</th>
<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANUFACTURERS</td>
<td>- Act as initiative sponsors</td>
<td>Low</td>
<td>High</td>
<td>Given that solution is capital intensive and costly to scale, manufacturers may be hesitant to invest</td>
</tr>
<tr>
<td></td>
<td>- Fund pilot and scale-up of solution</td>
<td></td>
<td></td>
<td>In addition, benefits are primarily to be gained at the sector level rather than specific to a certain brand – thus does not offer a significant competitive advantage vs. other manufacturers</td>
</tr>
<tr>
<td></td>
<td>- Provide product information for software configuration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Foster collaboration across manufacturers and regulatory agencies in order to improve solution effectiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FARMERS</td>
<td>- Need to actively participate in large numbers to start seeing immediate benefits of the network</td>
<td>Low</td>
<td>High</td>
<td>Requires a level of behavior change among farmers to ensure regular participation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ability to participate is influenced by degree of education provided in identifying counterfeit inputs</td>
</tr>
<tr>
<td>TECHNOLOGY SERVICE PROVIDERS</td>
<td>- Develop and maintain software platform</td>
<td></td>
<td>High</td>
<td>While the necessary development and operation components (i.e. call centers, software developers) are available, a ready-made solution for the target specifications does not currently exist</td>
</tr>
<tr>
<td></td>
<td>- Deliver data aggregation, processing and analysis capabilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Provide IT and consumer support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Work with MNOs to set-up hotline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOBILE NETWORKS</td>
<td>- Ensure reliable and consistent transfer of voice communications and SMS push notifications at no cost to consumer</td>
<td>Low</td>
<td>High</td>
<td>Mobile phone coverage may be inconsistent in rural regions</td>
</tr>
<tr>
<td>REGULATORY AGENCIES</td>
<td>- Follow-through on regulatory enforcement measures in order to reduce sources of counterfeiting</td>
<td>Low</td>
<td>High</td>
<td>Solution provides valuable intelligence on counterfeit activities, so regulators likely to be open to participation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>However, lack of resources may impede ability to prosecute offenders</td>
</tr>
</tbody>
</table>
### Information Collection and Dissemination Platform: Road Map

#### Steps to Implement an Information Collection and Dissemination Platform Solution

<table>
<thead>
<tr>
<th>Step</th>
<th>Duration</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1 | 2-3 weeks | **Target Market and Scale**  
- Identify target geographic market and value chains (prioritize value chains with strong farmer associations) |
| 2 | 6-10 weeks | **Constituent Engagement**  
- Identify appropriate technology service provider with which to partner  
- Develop consortium of partner sponsors (potentially across multiple manufacturers and regulatory agencies) |
| 3 | 10-14 weeks | **Initiative Configuration**  
- Set up call center infrastructure (labor and, training, call routing equipment, etc.)  
- Develop data capture and analysis software  
- Establish hot line and ISDN lines |
| 4 | 14-18 weeks | **Small-Scale POC**  
- Launch small-scale study to test viability  
- Train farmers on identifying counterfeit products  
- Identify lessons learned for broader roll-out, and evaluate full-scale rollout targets |
| 5 | Ongoing | **Large-Scale Rollout**  
- Roll-out solution across target markets  
- Since solution requires additional infrastructure investment and tailoring for each market, requires time to scale-up |
| 6 | Ongoing | **Ongoing Support**  
- Support solution adoption through ongoing marketing and promotion efforts, education programs, and stakeholder management initiatives |

Implementation of an information collection and dissemination platform solution will require approximately 8-11 months
Inventory Management Platform
Inventory Management Platform:
Solution Overview

Benefits of Solution to Delivery Channel

- **Sales Data Collection** – Captures up-to-date, location-specific sales data, such as package-size preferences, product types, and volume sold, which can be harnessed to adapt and optimize sales strategy.

- **Inventory Management & Reduce Stock-outs** – Frequent communication between suppliers and vendors enables manufacturers to better track inventory movement, reduce stock-outs, refine supply chain management systems, and enables learning and course correction to better meet demand and maximize outcomes.

- **Direct Link to Distributors** – By providing a direct channel to distributors, manufacturers can more easily communicate with and monitor actors along the supply chain.

1. **Agro Dealers** receive a weekly text message requesting stock information.
2. **Dealers** assess product inventory.
3. **Dealers respond** with stock level data and any other requested information (using smartphone).
5. **Manufacturers** analyze inventory information.
6. **Product is provided or re-distributed accordingly**.
Inventory Management Platform:
Case Study – SMS for Life Pilot in Tanzania

Results

- Stock outs were reduced from 79% to less than 26% in the three pilot districts
- Data accuracy (based on surveillance visits to health facilities) averaged ~94% during the pilot
- Response rate throughout the pilot was >93%, and fell to 80% during country scale up

Lessons Learned

- If accompanied by effective training, incentives, and manufacturer engagement, mobile-enabled inventory management systems offer a useful tool to manage inventory and reduce stock-outs
- While data accuracy can be efficiently monitored for small-scale initiatives (i.e. pilot stage), may be more difficult to validate quality of information after country-wide roll-out
- Broad consortium of partners from across public, private, and non-profit sectors helped to ensure program feasibility

Context – Supply chain issues at rural health facilities (where patients can get free drugs rather than having to pay for them at pharmacies) resulted in high stock-outs of essential drugs

Solution – SMS for Life was launched as a means to provide weekly status reports on stock levels to District Medical Officials, who then arrange for the provision or re-distribution of antimalarials

Partners – Partnership between Novartis, Vodafone and IBM, led by Roll Back Malaria and the Ministry of Health and Social Welfare, Tanzania

Scale – First piloted for 21 weeks across 129 health facilities in 3 districts in rural Tanzania
Inventory Management Platform: Implementation Assessment

### Success Factors

1. **Effective Training & Data Validation Mechanisms**
   
   Since the platform relies upon self-reported data, effective training is necessary in order to ensure agro dealers understand how to gather and record inventory information accurately. In addition, proper external mechanisms to test and encourage data accuracy help to ensure that the information collected is accurately reported.

2. **Adoption & Follow-Through**

   In order for the information on the platform to be valuable and up-to-date, dealers need to consistently respond to information requests promptly. In addition, manufacturers must quickly follow-through on information received through providing or re-distributing goods, otherwise actors along the supply chain will be disincentivized to regularly report information.

3. **Strategic ICT Partnerships**

   Partnership with a capable technology service provider plays an important role in the effectiveness of the solution—the technology is only valuable if the platform offered is scalable, reliable, and offers important data analytic insights for manufacturers.

### Potential Barriers to Implement Solution

1. **Accuracy of Data:** Data inaccuracies could stem from dealer carelessness when counting and reporting inventory level, or deliberate ill intentions

   **Implication:** There is a need to do randomized site visits in order to validate reported data, as well as establish positive incentives for accurate data and penalties for false reporting

2. **Fragmentation of Value Chain:** Distribution network for inputs is highly fragmented, with thousands of small, informal retailers. Thus, it may be difficult to include all distributors in platform—particularly for rural areas served by mobile agro dealers

   **Implication:** Stock-outs can be reduced at larger, more formal retail locations, but there may be gaps in data reporting at “last mile” of value chain, as distance between retailer and supplier increases

3. **Process Change Required:** Agro dealers typically record inventory manually (paper and pen); solution requires that they use technology to manage inventory, which they may find cumbersome or difficult to learn

   **Implication:** Agro dealers will need to effectively trained on the benefits of using the software; technology platform needs to be simple and easy to use
### Inventory Management Platform: Costs to Implement Solution

#### Cost Drivers¹
(Assumes 1000 Distributors)

<table>
<thead>
<tr>
<th>Component</th>
<th>USD (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Up Fee</td>
<td>$50-$250</td>
</tr>
<tr>
<td>Service Fee</td>
<td>$90-$100</td>
</tr>
<tr>
<td>Training Costs</td>
<td>$35-$45</td>
</tr>
<tr>
<td>Data Plan and Incentives</td>
<td>$105-$140</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$280-$535</strong></td>
</tr>
</tbody>
</table>

- **Set Up Fee**: One-time upfront fee that includes requirements gathering, system configuration and testing, and security certification. Fee varies from ~$50k - ~$250k depending on size and complexity of system.

- **Service Fee**: Includes software and servers, data management, support and maintenance.

- **Training Costs**: Training is approximately $30 - $40 per person for workshop; includes classroom demo materials, trainers, and travel expense for agro-dealers.

- **Data Plan and Incentives**: Data plans to enable smart device users to collect data, receive updates and training content are ~$8 / month.

- **Total**: Represents total on an annual basis – service fees, data plans, incentives, and additional training are recurring in nature.

(1) Based on interviews with technology service providers.

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Note: Costs are approximate.
# Inventory Management Platform:
## Players Required to Implement Solution

<table>
<thead>
<tr>
<th>Player</th>
<th>Role in Implementation</th>
<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Act as initiative sponsor&lt;br&gt;Align distribution network; work with agro dealer associations to map key agro dealers across regions&lt;br&gt;Provide funding for pilot and scale-up of solution</td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td>While the solution is not highly capital intensive it does require some upfront costs; manufacturers may be hesitant to invest these resources without assured returns&lt;br&gt;Manufacturers’ ability to participate varies upon current level of channel coordination in target market</td>
</tr>
<tr>
<td><strong>Farmers</strong></td>
<td>Limited role in implementation; no behavior change required for solution to be successful</td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td>Ability to participate depends on ability to pay for premium brands</td>
</tr>
<tr>
<td><strong>Technology Service Provider</strong></td>
<td>Maintain integrated reporting platform&lt;br&gt;Tailor configurations based on system requirements and provide IT support&lt;br&gt;Deliver data aggregation, processing and analysis capabilities</td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td>A number of technology providers offer readily available, end-to-end solutions for SMS polling and analysis</td>
</tr>
<tr>
<td><strong>Mobile Networks</strong></td>
<td>Ensure reliable and consistent transfer of communications at no cost to agro dealer</td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td>If platform is smartphone-based it would not require short code coordination, thus minimizing barriers to engaging with MNOs&lt;br&gt;While GSM coverage is fairly reliable, 3G coverage is typically only available in major cities</td>
</tr>
<tr>
<td><strong>Agro Dealers</strong></td>
<td>Active participation of agro dealers is crucial to the success of system</td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td><img src="Low.png" alt="Low" /> <img src="High.png" alt="High" /></td>
<td>Willingness varies depending upon accompanying incentives and education put in place&lt;br&gt;May require significant training investment in order to ensure that agro dealers are able to effectively participate in solution</td>
</tr>
</tbody>
</table>
Inventory Management Platform:
Road Map

Steps to Implement an Inventory Management Platform

1. **Target Market and Scale**
   - Identify target geographic markets and value chains
   - Work with agro dealer association to map agro dealers across regions
   - Refine project scope, technical requirements and desired outcomes

2. **Constituent Engagement**
   - Develop partnership with input manufacturer
   - Identify appropriate technology service provider to engage with

3. **Initiative Configuration**
   - Establish strategic objectives, and develop supporting tactical plan for pilot implementation
   - Understand key risks and develop mitigation strategies
   - Customize technology platform

4. **Small-Scale POC**
   - Launch pilot study to test viability
   - Identify lessons learned for broader roll-out strategy

5. **Market Scale-Up**
   - Roll-out solution across target markets

6. **Ongoing Support**
   - Support solution adoption through ongoing training programs and stakeholder management initiatives

Implementation of an inventory management platform will require approximately 5-7 months
RFID Tags
RFID Tags: Solution Overview

**Benefits of Solution to Delivery Channel**

- **Secure Solution** – Uniquely encoded RFID tags are difficult to counterfeit: they leverage password protection and encrypted labels to ensure security.

- **Robust Data Collection** – Data can not only be read from tags but new information can be added when tagged products change hands and are activated via a reader – enables manufacturers to capture more robust information (i.e. time stamps, prices, etc.)

- **Inventory Management** – Real-time updates allow for better tracking of inventory and re-allocation of stock; staff are not needed to scan products.

- **Batch Reading** – RFID solutions can read hundreds of tags at once from up to 100 meters away, reducing labor costs and scanning time.

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**RFID Tags**:

1. **Printers/Encoders** are used to produce RFID unique tags (labels).
2. **Manufacturer** places HF RFID tags on individual packages and UHF RFID tags on crates.
3. **RFID tags are initially read and products leave manufacturing facility.**
4. **Importers use RFID readers** to wirelessly scan UHF tags on crates and collect data.
5. **Distributors use RFID readers** to wirelessly scan HF tags on individual packages.
6. **Information is transmitted to a software database for collection and analysis.**
7. **Farmer buys the product from the retailer.**

**RFID technology can be passive or active.**

**Passive:**
- Tags require no power source
- Readers use power to emit signals 3-5 meters
- Readers collect/submit up to 128 bytes from 100+ tags

**Active:**
- Internal battery-powered tags; shorter shelf-life
- Readers use power to emit signals up to 100 meters
- Readers collect/submit data up to 128 kilo-bytes from 1000+ tags

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Note: (1) HF is High Frequency and UHF is Ultra High Frequency; (2) RFID readers can be fixed/mounted devices, PDAs, or tablets.
RFID Tags:  
Case Study – Pfizer Uses RFID Tags to Combat Fake Viagra

Pfizer’s Viagra and RFID Tags: Overview

- **Context** – In 2005, Pfizer’s Viagra market had grown to $1.6B globally; it’s popularity and price tag of $10 per pill made it a target for counterfeiting

- **Solution** – Pfizer piloted passive RFID tagging on all bottles, cases, and pallets of Viagra sold in the US; pharmacists and wholesalers use an RFID reader linked to an authentication software via a secure internet connection to read the product’s unique electronic code and validate authenticity

- **Partners** – Pfizer managed the pilot and commissioned hardware and software technology partners to produce: Tagsys’ high frequency RFID tags; Systech’s automated tagging process; Alien Technology’s ultra high frequency RFID tags; Philips’ RFID reader; and SupplyScape’s authentication software

- **Scale** – The year-long, $5M pilot was launched in 2005 on all 5 products under the Viagra brand sold in the United States, totaling 2.1 million bottles of Viagra

### Results
- In one year, large wholesalers completed 200,000 authentications at the item and case level; only 0.01% of authentications were “dead” and did not transmit a signal
- Pfizer extended RFID tagging to other product lines
- Tags on cases and pallets were authenticated more than tags on individual bottles

### Lessons Learned
- High frequency tags yield better results at an item-level and ultra high frequency tags are better on cases and pallets
- RFID can be effective for authentication but does not track and trace all products; 2D barcodes may be needed to complement the solution
- Mass acceptance of technology and standards is required to encourage adoption of the solution: “Retailers still say this needs to be an ROI-defining value proposition. I believe that is a barrier.”

Source: (1) RFID Journal; CIO Insight

“While the U.S. supply chain is still relatively safe from counterfeitters [compared to other countries], adopting RFID is most feasible in a highly regulated environment where the exchange of information is married to the secure transfer of the products.”

RFID Tags: Implementation Assessment

Success Factors

1. Tailored to Local Environment
   A number of factors can negatively impact the effectiveness of the solution (e.g., contact with heat, water, metal, etc.); therefore, RFID hardware and software need to be tested and tailored to the local environment where the technology will be used.

2. Adoption of Technology
   Importers, distributors, and agro dealers must use RFID readers to ensure end-to-end validation; scanning must occur at each point along the value chain in order for the solution to work effectively.

3. Enabling Technology Environment
   The local technology environment is critical to the solution’s success: reliable internet connectivity is required to transmit information to a secure database, and uninterrupted high or ultra high frequency radio waves where readers are deployed – is needed for technology to work effectively.

Potential Barriers to Implement Solution

1. Radio Frequency Inhibitors: RFID readers may miss authenticating tags due to inhibitors: radio waves can be absorbed by water or shielded by metals, and when packed tightly, passive RFID tags may be shielded by other tags
   Implication: In instances when product may come in contact with heat, water, metal or other inhibitors, use 2D barcodes as a back-up to ensure individual items are authenticated

2. Expensive to Implement: Cost of tags and readers vary significantly depending on features included in solution; as a result, technology will be costly to implement
   Implication: Invest in low cost, innovative RFID tags and readers (although effectiveness is reduced when low-cost tags and readers are used)

3. High Risk: RFID is an unproven technology system within agricultural input sectors; manufacturers will be apprehensive to be a first-mover without clear ROI
   Implication: Provide guarantees, start-up capital or training to manufacturers to minimize risk and incentivize implementation of the solution
RFID Tags:
Costs to Implement Solution

Cost Drivers¹
(Assumes 1.5M packages, 1000 Distributors)

- **Set Up Costs**: $2435-$3100
  - Costs associated with handheld readers ($2,500 per reader for each distributor)
  - Other costs include: associated software, fixed readers, and RFID printers

- **RFID Tags**: $375-$525
  - Costs associated with RFID high frequency tags (at ~$0.30 each, affixed to each of the 1.5M packages)
  - Other marginal costs for crate tags

- **Manufacturing Investment**: $1400-$1600
  - Costs associated with changing the packaging process to incorporate RFID tagging, and to integrate systems (software) with new technology
  - Estimate based on industry average (~30% of total cost)

- **Technology Maintenance**: $290-$375
  - Includes maintenance updates of hardware and software
  - Estimate based on industry average (~10% of hardware and software costs)

- **Training**: $30-$40
  - Training is approximately $30 - $40 per agro dealer for workshop; includes classroom demo materials, trainers, and travel costs

- **Total**: $4530-$5640
  - Represents total costs to implement – all costs recur annually except set-up costs and manufacturing investment

Note: Costs are approximate

Note: (1) Costs vary depending on whether manufacturers have in-house capacity or outsource to other providers; costs are based on current RFID technology (research indicates that new innovative RFID solutions may emerge that drive down the cost of RFID tags and readers)
RFID Tags:
Players Required to Implement Solution

<table>
<thead>
<tr>
<th>Player</th>
<th>Role in Implementation</th>
<th>Willingness to Participate</th>
<th>Ability to Participate</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturers</td>
<td>- Manage supply chain and inventory tracking process</td>
<td>Low</td>
<td>High</td>
<td>Manufacturers may be unwilling to participate given the high cost of implementation and changes in packaging processes and software integration</td>
</tr>
<tr>
<td></td>
<td>- Build distributor relationships</td>
<td></td>
<td></td>
<td>May be difficult for manufacturers to implement given lack of local presence in country (which would be required to launch solution across value chain)</td>
</tr>
<tr>
<td></td>
<td>- House relevant IT staff members to manage solution providers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Link technology with enterprise resource management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributors/Agro Dealers</td>
<td>- Implement reader technology</td>
<td>Low</td>
<td>High</td>
<td>May be unwilling to participate given process change required; current tracking is rudimentary; players would require significant training</td>
</tr>
<tr>
<td></td>
<td>- Read and update data on RFID tags to track products end-to-end</td>
<td></td>
<td></td>
<td>A degree of technical know-how is required to use the readers; on-site maintenance resources are limited</td>
</tr>
<tr>
<td>Farmers</td>
<td>- Limited role in implementation; no behavior change required for solution to be successful</td>
<td>High</td>
<td>Low</td>
<td>Ability to participate depends on farmer's access to agro dealers carrying RFID-tagged products</td>
</tr>
<tr>
<td>RFID Solution Provider</td>
<td>- Provide RFID hardware and software and ongoing maintenance</td>
<td>High</td>
<td>Low</td>
<td>There are a number of tech. providers that could offer the solution abroad</td>
</tr>
<tr>
<td></td>
<td>- Integrate solution with manufacturers existing information systems</td>
<td></td>
<td></td>
<td>Challenges in the local context may limit ability to implement effectively (e.g., humid temperatures)</td>
</tr>
</tbody>
</table>
Implementation of a Radio Frequency Identification solution will require approximately 8-10 months.
To summarize, we assessed six leading solutions that have been effective in other industries to tackle counterfeiting:

<table>
<thead>
<tr>
<th>BARCODE APPLICATIONS</th>
<th>MOBILE TESTING KITS</th>
<th>COIN SCRATCH &amp; MOBILE AUTHENTICATION</th>
<th>INFORMATION DISSEMINATION PLATFORM</th>
<th>INVENTORY MANAGEMENT PLATFORM</th>
<th>RFID TAGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Provides full supply chain visibility</td>
<td>• Improves quality across value chain</td>
<td>• Provides direct channel to consumer</td>
<td>• Strengthens markets</td>
<td>• Reduces stock-outs</td>
<td>• Offers secure solution</td>
</tr>
<tr>
<td>• Provides valuable channel data</td>
<td>• Delivers data to inform channel investment-decisions</td>
<td>• Enables brand protection</td>
<td>• Delivers data to inform channel investment-decisions</td>
<td>• Provides valuable channel data</td>
<td>• Delivers data to inform channel investment-decisions</td>
</tr>
<tr>
<td>• Improves inventory mgmt. processes</td>
<td>• Sources data from “crowd” of farmers</td>
<td>• Provides valuable consumer data</td>
<td>• Establishes direct link to channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Process change required (need to scan all inventory)</td>
<td>• Expensive R&amp;D investment</td>
<td>• Requires farmer literacy</td>
<td>• Risk of garbage-in, garbage-out</td>
<td>• Process change required</td>
<td>• Expensive to implement</td>
</tr>
<tr>
<td>• Easy to replicate</td>
<td>• Unproven solution</td>
<td>• Assumption of risk (return policy?)</td>
<td>• Scale required</td>
<td>• Accurate, reliable data required</td>
<td>• High risk; unproven w/ agri. inputs</td>
</tr>
<tr>
<td>• High reliance on human capital</td>
<td>• Only effective when package integrity is maintained</td>
<td>• Only effective when package integrity is maintained</td>
<td>• Difficult to keep track of mobile retailers</td>
<td>• Difficult to keep track of mobile retailers</td>
<td>• Requires significant process change</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 - 8 months</td>
<td>7 - 9 months</td>
<td>5 - 7 months</td>
<td>8 - 11 months</td>
<td>5 - 7 months</td>
<td>8 - 10 months</td>
</tr>
<tr>
<td>Viability of Solution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="false" alt="Ineffective" /></td>
<td><img src="false" alt="Ineffective" /></td>
<td><img src="true" alt="Effective" /></td>
<td><img src="true" alt="Effective" /></td>
<td><img src="true" alt="Effective" /></td>
<td><img src="true" alt="Effective" /></td>
</tr>
</tbody>
</table>

---

Ineffective

---

Effective
There are certain contextual factors required in order for these solutions to be applicable within an agricultural input sector of a given country (1 of 2)

<table>
<thead>
<tr>
<th>Contextual Factors Required for Solution to be Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barcode Applications</strong></td>
</tr>
<tr>
<td>- Package integrity is maintained through distribution process</td>
</tr>
<tr>
<td>- Retailers have capacity to learn &amp; use scanning tools</td>
</tr>
<tr>
<td>- Agro dealer locations are mapped and have unique identifying features (e.g., GPS coordinate of location, phone number, etc.)</td>
</tr>
<tr>
<td><strong>Mobile Testing Kits</strong></td>
</tr>
<tr>
<td>- Agro dealer locations are mapped and have unique identifying features (e.g., GPS coordinate of location, phone number, etc.)</td>
</tr>
<tr>
<td>- Less fragmentation and intermediation enables manufacturers to keep track of distributor network</td>
</tr>
<tr>
<td><strong>Coin Scratch &amp; Mobile Authentication</strong></td>
</tr>
<tr>
<td>- Package integrity is maintained through distribution process</td>
</tr>
<tr>
<td>- Agro dealers are familiar with scanning technology or SMS</td>
</tr>
<tr>
<td><strong>Information Dissemination Platform</strong></td>
</tr>
<tr>
<td>- Agro dealer locations are mapped and have unique identifying features (e.g., GPS coordinate of location, phone number, etc.)</td>
</tr>
<tr>
<td><strong>Inventory Management Platform</strong></td>
</tr>
<tr>
<td>- Branded product stock-out is a source of counterfeiting</td>
</tr>
<tr>
<td>- Less fragmentation and intermediation enables manufacturers to keep track of distributor network</td>
</tr>
<tr>
<td>- Agro-dealers use smartphones</td>
</tr>
<tr>
<td><strong>RFID Tags</strong></td>
</tr>
<tr>
<td>- Package integrity is maintained through distribution process</td>
</tr>
<tr>
<td>- Retailers have capacity to learn and use RFID readers</td>
</tr>
<tr>
<td>- Agro dealer locations are mapped and have unique identifying features (e.g., GPS coordinate of location, phone number, etc.)</td>
</tr>
</tbody>
</table>

**Channel Considerations**

- Reused labels and bottles of premium brands
- Imitation brands/labels of premium brands

**Counterfeiting Types Addressed**

- Reused labels and bottles of premium brands
- Imitation brands/labels of premium brands
- Applicable for all types of counterfeiting (product that is sub-standard/adulterated, mislabeled product, and reused labels and bottles)
- Product stock-outs
- Reused labels and bottles of premium brands
- Imitation brands/labels of premium brands

**Manufacturer Considerations**

- Manufacturer is not the source of adulterated or sub-standard products
- Private brands play a role in purchasing decision of farmers
- Private brands play a role in purchasing decision of farmers
- Manufacturer is not the source of adulterated or sub-standard products

- N/A
There are certain contextual factors required in order for these solutions to be applicable within an agricultural input sector of a given country (2 of 2)

<table>
<thead>
<tr>
<th>Contextual Factors Required for Solution to be Applicable</th>
<th>Barcode Applications</th>
<th>Mobile Testing Kits</th>
<th>Coin Scratch &amp; Mobile Authentication</th>
<th>Information Dissemination Platform</th>
<th>Inventory Management Platform</th>
<th>RFID Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallholder Farmer Considerations</td>
<td>Farmers are familiar with w/SMS and trust it as a reliable source of information</td>
<td>Farmers trust and understand the value of purchasing inputs through certified channel</td>
<td>Farmers are familiar with w/SMS and trust it as a reliable source of information</td>
<td>Large numbers of farmers buy and use agricultural inputs</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Technology Environment</td>
<td>Reliable connectivity to secure database (i.e. power, internet, bandwidth)</td>
<td>Reliable connectivity to secure database (i.e. power, internet, bandwidth)</td>
<td>Reliable connectivity to secure database (i.e. power, internet, bandwidth)</td>
<td>Reliable mobile network connectivity</td>
<td>Reliable connectivity to secure database (i.e. power, internet, bandwidth)</td>
<td>Reliable connectivity to secure database (i.e. power, internet, bandwidth)</td>
</tr>
<tr>
<td>Human Capital Considerations</td>
<td>Pipeline of talent exists (i.e. agricultural education programs); quality assurance professionals are needed</td>
<td>N/A</td>
<td>N/A</td>
<td>Access to human capital who understand the local language and can be trained on use of software application and types of counterfeiting</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
For herbicide markets in Ghana and Uganda, the most applicable solutions include: Coin Scratch & Mobile Authentication, Information Dissemination Platform, and Inventory Mgmt. Platform

Herbicide Value Chain
Ghana & Uganda

- Manufacturers
- Importers
- Distributors
- Agro Dealers
- Mobile Salesmen
- Smallholders
- Large Farms

Value Chain Facts Relevant for Solution Selection

- Package integrity is maintained across entire value chain
- Significant degree of fragmentation: thousands of agro dealers
- Significant degree of intermediation: product is sold 4-6 times across value chain
- There is no domestic manufacturing of herbicides

Applicable Solutions

**Coin Scratch & Mobile Authentication**
- Least costly solution to address counterfeiting
- The primary types of counterfeiting are bottle/label reuse of premium brands and label imitation of premium brands. Coin scratch & mobile authentication would effectively address these types of counterfeiting.
- Leverages existing technologies that farmers/agro dealers are familiar with

**Information Dissemination Platform**
- Leverages existing technologies that farmers are familiar with and use: mobile phones w/ push notifications
- Farmers trust their peers/friends for information on products and agro dealers
- Challenge: would require significant training investment to reach scale; scale is required for solution to be effective

**Inventory Management Platform**
- Addresses one of the primary root causes of counterfeiting: agro dealer stock-outs; if agro dealers are able to stock the brands that farmers demand, they are less incentivized to adulterate products/packages
- Challenge: depends on agro dealers adopting technology; significant training investment required

(1) Note: Mobile testing kits is deprioritized because package integrity is maintained in the herbicide value chain; as long as quality product enters the value chain, smallholders will use quality product; barcode applications and RFID tags would be applicable but are deprioritized because they require a significant investment in technology tools that importers, distributors, agro dealers and mobile salesmen do not currently use.
For the maize seed market in Ghana, the most applicable solution is an Information Dissemination Platform.

**Value Chain Facts Relevant for Solution Selection**

- High degree of uniformity in the market, in terms of product and packaging; private brands do not play a significant role.
- High degree of public sector involvement in market: up until 2010, the government mandated the use of standard plastic seed bags, which are still primarily used by most seed companies.
- Significant degree of fragmentation: thousands of seed producers for a relatively small market.

**Applicable Solutions**

1. **Leverages existing technologies that farmers are familiar with and use: mobile phones w/ push notifications**
2. **Farmers trust peers for information on products and distributors**
3. **Challenge: would require significant investment to reach scale, and margins on maize seed are relatively low**
4. **Challenge: there is little product differentiation, so may be difficult for farmers to provide meaningful product-level information on counterfeiting**

---

(1) Note: Coin scratch & mobile authentication, barcode applications, and RFID solutions are all deprioritized because packages are provided by the government and limited private branding/labeling occurs; inventory management platform is deprioritized because product stock-outs are not a source of counterfeiting in Ghana’s maize seed sector.
For the maize seed market in Uganda, the most applicable solutions include: Coin Scratch & Mobile Authentication and Information Dissemination Platform

Maize Value Chain: Uganda

Value Chain Facts Relevant for Solution Selection

- Seed is typically sold in 2 kg bags which are packaged by the seed company, but bulk breaking can occur when farmers cannot afford standard package sizes
- High levels of intermediation in distribution chain
- Brands play a role in purchase behavior; certain foreign and domestic companies are well known and sought out by farmers

Applicable Solutions¹

**COIN SCRATCH & MOBILE AUTHENTICATION**

- Least costly solution to address counterfeiting
- Leverages existing technologies that farmers/agro dealers are familiar with
- Effectively addresses imitation packages of leading seed companies
- Challenge: would not be effective in cases where farmers cannot afford standard seed package size and bulk breaking occurs

**INFORMATION DISSEMINATION PLATFORM**

- Leverages existing technologies that farmers are familiar with and use: mobile phones w/ push notifications
- Farmers trust peers for information on products and distributors
- Challenge: it is only after germination, or a lack thereof, when the farmer realizes the quality of the seed; this lead-time may render reported information less valuable

(1) An inventory management platform would be less effective because it is difficult to immediately adapt production levels to meet market demand (they may be unable to provide additional stock until the next season); barcode applications and RFID tags would be applicable but are deprioritized because they require a significant investment in technology tools that importers, distributors, agro dealers and mobile salesmen do not currently use.
For the fertilizer market in Uganda, the most applicable solutions include: RFID & Barcode Applications, Mobile Testing Kits, and Information Dissemination Platform

**Fertilizer Value Chain: Uganda**

**Value Chain Facts Relevant for Solution Selection**

- Majority of fertilizer volume is sold to large commercial farms; very little usage by smallholders
- Import companies distribute 50kg bags, which farmers cannot afford; distributors break the packages into smaller sizes to cater to farmer demand
- There is no domestic production of fertilizer, and Uganda’s landlocked location introduces increased opportunity for bulk-breaking and counterfeiting to occur

**Applicable Solutions**

### RFID & Barcode Applications

- RFID tags could be used when product is imported in bulk to shipping ports (e.g., Mombasa) to verify product flow at initial steps of value chain; when product is re-packaged in smaller bags, barcode applications could be leveraged on each individual unit to track flow of input until it reaches the farmers
- Challenge: Importers/Distributors are often involved in counterfeiting activities; would require manufacturers to have local packaging operation

### Mobile Testing Kits

- A mobile testing kit program would effectively address instances of diluted fertilizer
- Challenge: Given the complexity involved in the path of fertilizer from overseas manufacturer to consumer, solution would require significant investment

### Information Dissemination Platform

- Leverages existing technologies that farmers are familiar with and use: mobile phones w/ push notifications
- Farmers trust peers for information on products and agro dealers
- Challenge: given that very few farmers use fertilizer currently, it is unlikely that scale required for solution to be effective could be achieved unless demand for product increased

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(1) Note: All solutions in fertilizer value chain would likely be uneconomic given low margins on fertilizer. Furthermore, coin scratch & mobile authentication is not feasible because of the prevalence of bulk breaking; an inventory management platform would not be an effective anti-counterfeiting solution because out-of-stocks do not play a significant role in driving counterfeiting activity.
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- Value Chain Analysis & Selection
- Value Chain Assessments
  - Ghana: Overview & Existing Initiatives to Address Counterfeiting
  - Ghana: Herbicide
  - Ghana: Maize Seeds
  - Uganda: Overview & Existing Initiatives to Address Counterfeiting
  - Uganda: Herbicide
  - Uganda: Maize Seeds
  - Uganda: Inorganic Fertilizer
- Assessment of Technological Environment in Ghana & Uganda
- Summary of Solutions
- Assessment of Each Solution
- Applicability of Solutions
- **Path Forward & Recommendation**
We believe that markets will develop over a period of time, at which point the challenge of counterfeiting will be less of a problem

<table>
<thead>
<tr>
<th>Expected Trend</th>
<th>Impact on Counterfeiting Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHANNEL CONSOLIDATION</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>As leading distributors/retailers emerge and grow their market share, channels will increasingly consolidate. Companies will use channel strategies, such as direct to market, channel incentives, and exclusive supply agreements, to gain a competitive advantage. Manufacturers will develop stronger relationships with key distributors/retailers, better manage their inventory, and have more visibility into how products reach the end-user. In this context, delivery channels become less complex, making it easier to track products and address counterfeiting issues.</td>
</tr>
<tr>
<td><strong>CONSUMER CONSOLIDATION</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>By 2030, 50% of Africans are expected to live in cities. As smallholder farmers move to urban environments, land ownership will become increasingly consolidated through informal or formal mechanisms, unlocking opportunities for farming at scale. With increased access to larger plots of land, the quantity of agricultural inputs demanded will increase. Mid-to-large scale farmers will demand commercial volumes of agricultural inputs, and thus there will be fewer opportunities for small bottles and labels to be reused and sold.</td>
</tr>
<tr>
<td><strong>MANUFACTURER INVESTMENT</strong>&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Understated demand, strong growth forecasts, under-utilized arable land, and opportunities for public-private partnerships will incentivize manufacturers to increasingly invest in Africa’s agricultural markets. As manufacturers establish local presence and build stronger relationships with local distributors or vertically integrate, they will be able to better track products through the supply chain and gain greater visibility into counterfeiting activities.</td>
</tr>
<tr>
<td><strong>CONSUMER SOPHISTICATION</strong>&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Farmers will become more savvy, informed, and educated. Increased government and donor spending and social sector innovations are expected to continue to improve literacy in Africa. As farmers become more sophisticated, they will be better equipped to identify counterfeit products and demand authentic ones; as a result, those selling counterfeits will be forced out of the market.</td>
</tr>
<tr>
<td><strong>TECHNOLOGY PENETRATION</strong>&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Technology will become increasingly adopted across the value chain; manufacturers, distributors/retailers, and farmers will use more sophisticated technologies as affordable solutions enter the market. Technology will allow users to better manage inventory, predict demand, and gain access to real-time, useful data. Manufacturers can use technology to more effectively share counterfeit information with customers (and vice versa) as well as track genuine products through the supply chain.</td>
</tr>
</tbody>
</table>

Notes: (1) 80% of Investment Promotion Agencies believe African agriculture is the most promising sector for attracting greater FDI; over 325M Africans are employed in agriculture; demand for food in Africa is expected to grow to $1 Trillion by 2030; Africa’s share of the world’s total amount of uncultivated, arable land is 60%; (2) 20% of African government expenditures are on education; compared to 10% in OECD countries
Sources: UNCTAD; McKinsey Global Institute; World Bank

Over the next 5-10 years, African agricultural markets will significantly change; these changes will simultaneously address the challenges posed by counterfeiting
In order to catalyze market development, inefficiencies in delivery channels need to be addressed

Inefficiencies Across Agricultural Input Delivery Channels

**Source of Inefficiency: Degree of Intermediation**: Product is sold between 4 and 6 times before it reaches the end consumer

**Implication**: Manufacturers have limited knowledge/visibility of consumer purchase behavior, channel activities, or instances in which product/package is tampered with

**Source of Inefficiency: Fragmentation Across Value Chain**: Distributor and agro-dealer channel is highly fragmented; thousands of small retailers

**Implication**: Manufacturers have limited knowledge/visibility of product and brand preferences, price points of product sold, and channel incentives

**Source of Inefficiency: Lack of Local Presence by Manufacturers**: CPPs and fertilizers are manufactured abroad, and sold into country through importers

**Implication**: Manufacturers lack incentives to address challenges faced in-country, and don’t make investments in marketing activities

**Source of Inefficiency: Rudimentary Inventory Management**: Tracking of inventory across value chain and at POS is conducted with paper and pencil

**Implication**: Manufacturers have limited knowledge/visibility of consumer behavior, channel, market, and competitive dynamics
When solving for market development inefficiencies – as opposed to solving solely for the challenge of counterfeiting – the potential solution set becomes much broader.

**Categories of Solutions that Address Counterfeiting**

- **Solutions to Professionalize Delivery Channels**
  - Strengthened regulatory environment
  - Channel consolidation
  - Direct-to-market strategies
  - Strong supplier-retailer relationships
  - Vertical integration
  - Specialized and knowledgeable labor force

- **Solutions Addressing Supply Chain Inefficiencies and Counterfeiting**
  - Inventory management solutions
  - Track-and-trace technologies (e.g., barcodes, RFID tags)
  - Quality assurance and certified channels

- **Point Solutions to Counterfeiting**
  - End-user authentication
  - Information collection and dissemination platform
  - Manufacturers’ investments in packaging (e.g., tamper-proof seals, holograms), or products (e.g., unique dyes)

*The primary focus of the current study was on anti-counterfeiting solutions that leverage scalable technological innovations that manufacturers may be willing to invest in if the cost to implement is less than the incremental profit generated.*
We believe that the role for the Gates Foundation should be driven by the maturity of anti-counterfeiting solutions.

### Maturity of Anti-Counterfeiting Solutions in African Agricultural Input Sectors

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Potential Role for BMGF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Framing</strong></td>
<td>At this stage, the technology exists, actors are aware of technology and potential applicability, but certain constraints are inhibiting adoption</td>
<td>Fund a challenge prize to adapt solution to the sector and/or unlock further innovations</td>
</tr>
<tr>
<td><strong>Prototyping</strong></td>
<td>At this stage, leading companies understand requirements involved, are developing innovative ways to address constraints, and have begun to apply the technology in the sector</td>
<td></td>
</tr>
<tr>
<td><strong>Performing</strong></td>
<td>At this stage, the solution has been tested in the sector and tangible evidence of performance exists</td>
<td>Invest in a pilot to assess effectiveness and potential for large scale rollout</td>
</tr>
<tr>
<td><strong>Optimizing</strong></td>
<td>At this stage, the solution has been scaled broadly and the focus is on delivering superior value</td>
<td></td>
</tr>
</tbody>
</table>

The current maturity level of the anti-counterfeiting solution is a key factor in determining the best next steps for the Gates Foundation.
Manufacturers could invest in a number of different package and product innovations to tackle counterfeits; a few examples are highlighted below:

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th><strong>Potential Shortcomings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALPVISION CRYPTOGLYPH</strong></td>
<td><strong>Means of Authentication:</strong> Relies on use of either a flatbed scanner, smartphone, or USB microscope connected to a PC operating system in order to authenticate – devices which smallholder farmers are not likely to have access to</td>
</tr>
<tr>
<td>Digital image file that contains encrypted information by embedding a pseudo-random pattern of microdots in the packaging graphic, which are invisible to the naked eye</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
<tr>
<td><strong>ALPVISION FINGERPRINT</strong></td>
<td><strong>Means of Authentication:</strong> Relies on use of either a flatbed scanner, smartphone, or USB microscope connected to a PC operating system in order to authenticate – devices which smallholder farmers are not likely to have access to</td>
</tr>
<tr>
<td>Leverages the surface irregularities found in a mold of a component of the product packaging (i.e. cap on a bottle) and uses these unique characteristics as the means of authentication</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
<tr>
<td><strong>HOLOGRAMS</strong></td>
<td><strong>Level of Security:</strong> Holograms are easy to manufacture and duplicate; some companies are developing more sophisticated holograms that require UV light or a special reader, which would require additional investment</td>
</tr>
<tr>
<td>Optical security elements formed by the interference of light beams from a laser or other light source to produce a 3D image; holograms for brand protection may include dot matrices, 2D/3D images, flip effects, hidden features, true color shifts and micro-text</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
<tr>
<td><strong>PRODUCT DYES</strong></td>
<td><strong>Level of Security:</strong> Dyes are accessible and easy to replicate; not a long-term solution to counterfeiting</td>
</tr>
<tr>
<td>Color or fluorescent dyes are customized and applied to the product as a unique identifier</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
<tr>
<td><strong>SECURITY INK</strong></td>
<td><strong>Level of Security:</strong> Ink is easy to replicate and requires constant changes to packaging to outsmart dealers who replicate the security features</td>
</tr>
<tr>
<td>Fluorescent dyes and luminescent pigments are customized and printed in patches on specific surfaces and places on a product to create a unique signature</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
<tr>
<td><strong>TAGGANT TECHNOLOGY</strong></td>
<td><strong>Means of Authentication:</strong> Relies on use of tailored, expensive handheld readers and detectors – devices which smallholder farmers are not likely to have access to</td>
</tr>
<tr>
<td>Microscopic materials that are uniquely encoded into or on a product or package (including liquids and solids)</td>
<td><strong>Potential Shortcomings:</strong> See description</td>
</tr>
</tbody>
</table>

Sources: Expert interviews; service providers’ websites
## Industry Associations & Extension Networks: Ghana

| **Apex Farmer’s Organization of Ghana (APFOG)** | • Apex organization for farmer-based groupings in Ghana  
• Mission is to unify all farmer-based organizations in Ghana under one umbrella in order to lobby and advocate for farmer-friendly policies |
| **Ghana Agricultural Associations Business & Information Centre (GAABIC)** | • Consortium of 4 agricultural associations: Apex Farmers’ Organization of Ghana (APFOG), CropLife Ghana (CLG), Ghana Agri-Input Dealers Association (GAIDA) and Seed Producers Association of Ghana (SEEDPAG) |
| **GHASTA** | • Seed company association with 10 member seed companies thus far  
• Recently formed (still in the process of registration), and distinct from SEEDPAG in that it is more commercially-focused |
| **CropLife Ghana** | • International federation of agricultural biotechnology companies  
• CropLife Ghana has 13 member companies: Wienco, Dizengoff, Yara, Chemico, Calli Ghana, Sidalco, Saro Agrosciences, Golden Stork, Makteshimagan, Bayer Cropscience, Wynca Sunshine, and Reiss & Co |
| **Ghana Agri-Input Dealers Association (GAIDA)** | • National body of agricultural input dealers with over 3,425 members nationally  
• Provides business and technical training programs, assistance in gaining access to credit, and other advocacy initiatives |
| **Masara N’Arziki Farmers Association (MAFA)** | • Out grower scheme sponsored by Yara and Wienco, in which inputs are supplied to farmers on credit and repaid after harvest  
• Currently covers Brong-Ahafo, Northern, Upper West and Upper East regions, with 22,000 acres for more than 5,000 farmers |
| **Seed Producers Association of Ghana (SEEDPAG)** | • Seed producer association with 310 registered members  
• Goal is to empower seed producers and grow Ghana’s seed industry through influencing policy and market dynamics |
## Industry Associations & Extension Networks: Uganda

| **Uganda Seed Trade Association (USTA)** | - Membership association to oversee and coordinate the development of the Ugandan seed industry  
- The Association currently has a total of 27 members of whom 23 are seed companies and 4 are associate members |
| **CropLife Uganda** | - International federation of agricultural biotechnology companies  
| **Uganda National Agro-Input Dealer Association (UNADA)** | - Agro-dealer association, aiming to provide meaningful services to its members. These services include networking, advocacy and lobbying, credit linkages, etc.  
- 1300 members |
| **National Agricultural Advisory Services (NAADS)** | - A semi-autonomous public agency within the Ministry of Agriculture Animal Industry and Fisheries (MAAIF), responsible for public agricultural advisory/extension services  
- The mission of NAADS is to increase farmers’ access to information, knowledge and technology for profitable agricultural production |
### Counterfeit Agro-Chemicals in Uganda

<table>
<thead>
<tr>
<th></th>
<th>Genuine</th>
<th>Fake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>US$6.1 (UGX15,000)</td>
<td>US$4.0 (UGX10,000)</td>
</tr>
<tr>
<td><strong>Cap-seal</strong></td>
<td>Closely in-tact</td>
<td>Gaps appears; may have been broken</td>
</tr>
<tr>
<td><strong>Foil</strong></td>
<td>Follows shape of bottleneck</td>
<td>Does not follow shape of bottleneck</td>
</tr>
<tr>
<td><strong>Consistency</strong></td>
<td>Less foam</td>
<td>More foam</td>
</tr>
<tr>
<td><strong>Print</strong></td>
<td>High-quality, professional appearance</td>
<td>Lower quality label</td>
</tr>
<tr>
<td><strong>Hologram</strong></td>
<td>Next to the “d,” right side up</td>
<td>Covering part of the “d,” upside-down, slanted</td>
</tr>
</tbody>
</table>

**Genuine**

- Foil follows the shape of the bottleneck.
- Cap-seal is closely intact.
- Consistency shows less foam.
- Print appears high-quality, professional appearance.
- Hologram is located next to the “d,” right side up.

**Fake**

- Foil does not follow the shape of the bottleneck.
- Cap-seal appears to have gaps, possibly indicating it has been broken.
- Consistency shows more foam.
- Print appears lower quality label.
- Hologram is covering part of the “d,” upside-down, slanted.
Counterfeit Agro-Chemicals in Uganda
Counterfeit Agro-Chemicals in Ghana

**Dursban**: Authentic brand manufactured by Dow AgroSciences

**Dursband**: Counterfeit brand by unknown manufacturer
Counterfeit Agro-Chemicals in Ghana

**RoundUp**: Authentic brand manufactured by Monsanto

**RoundUp**: Counterfeit brand manufactured by Sunshine
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