SMALLHOLDER MAIZE PRODUCTION EFFICIENCY IN KENYA

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Regional Workshop on an Integrated Policy Approach to Commercializing Smallholder Maize Production
6th – 7th June, 2012 - The Norfolk Hotel, Nairobi, Kenya
Outline

- Introduction
- Efficiency in maize production
  - Trends in maize production and yield
  - Kenya and other countries’ maize yield compared
  - Technical efficiency in Kenya’s smallholder maize production
- How to improve smallholder efficiency
Introduction

- Agriculture in Kenya undoubtedly important
  - Food source
  - Employment; >70% of rural & 18% of formal employment
  - Income; a large majority of rural households
- Performance of sector has a great bearing on both food security and overall economic growth
- Four main challenges in the sector:
  - Low productivity
  - Low value addition
  - Under-developed and inefficient markets (inputs and output)
  - Inefficient land use
Introduction (cont)

- Sector development strategy:
  - Increasing productivity, commercialization and competitiveness
  - Developing and managing key factors of production

- Small-scale farming pre-dominates:
  - 75% of total agricultural output
  - 70% of marketed output

- Increasing efficiency of smallholder key to achieving sector’s development goals
EFFICIENCY IN MAIZE PRODUCTION
Trends in Maize Production and Yield

- Maize is a staple food to a large proportion of people in Kenya
  - Nearly all agricultural households plant maize

- Small-scale production dominates
  - 70% of total production

- There has, however, been evidence of stagnation in maize production and productivity
  - Increasing gap between production and consumption
  - Increasing frequency of supply shortages
Widening gap between maize production and consumption in the last decade

Trend in Kenya's Population and Maize Production & Consumption

Data source: Ministry of Agriculture: Economic Review of Agriculture – Various Issues
Smallholder maize yield increased by 285kg/ha (17.3%) between 2000 and 2010.

Data source: Tegemeo Institute Household Panel Survey, 2000-2010
## Comparison of Kenya’s Maize Yield (Kg/ha) to other countries’

<table>
<thead>
<tr>
<th>Kenya</th>
<th>Comparison countries (FAOSTAT data 2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tegemeo Panel (2009/10) - 1,934</td>
<td>South Africa - 4,964</td>
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<tr>
<td>FAOSTAT (2009) – 1,294</td>
<td>Malawi – 2,227</td>
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<td></td>
<td>Zambia – 2,069</td>
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<td></td>
<td>Uganda – 1,434</td>
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<td>Tanzania – 1,123</td>
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</table>
Efficiency of Smallholder Maize Production

- A policy challenge in the maize subsector is how to improve efficiency through:
  - reduction of production and marketing costs
  - and appropriate use of appropriate inputs

- The strategy should ensure:
  - acceptable profitability for the producers and lower food prices for the consumers; and
  - improvement in competitiveness in maize production

- One pathway toward improving productivity is to improve efficiency - technical and allocative
Efficiency of Smallholder Maize Production (cont)

- Technical efficiency involves maximization of output from a given quantity of inputs
  - the ratio of the observed output to the corresponding frontier output, conditioned on the level of inputs used

- Allocative efficiency reflects the optimal choice of input levels and proportions
  - using an input at the level where its marginal physical product equals its input/output price ratio

- Technical and allocative efficiency can be combined into a measure of total economic efficiency, referred to as cost efficiency
Efficiency of Smallholder Maize Production (cont)

- Smallholder technical efficiency ranges from 7.2% to 98.3%, with a mean of 49%
  - There is scope of increasing maize production by 51% through adopting technologies and techniques used by best maize farmers
- Over 36% of maize farmers operate below the mean technical efficiency level; only 30% are at least 60% technically efficient

Source: Kibaara (2005)
Efficiency of Smallholder Maize Production (cont)

- Technical efficiency ranges wide across zones; efficiency lowest in low potential and highest in high potential zone
  - Efficiency of 59% of farmers in low potential zone is less than 40%
  - Efficiency of 62% of farmers in high potential zone is at least 60%

<table>
<thead>
<tr>
<th>Range of TE in Percent</th>
<th>Agro-regional zone</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Low&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Medium&lt;sup&gt;b&lt;/sup&gt;</td>
<td>High&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Overall</td>
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<tr>
<td>&lt;20</td>
<td>13.1</td>
<td>7.2</td>
<td>1.7</td>
<td>7.2</td>
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<tr>
<td>20-39</td>
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<td>29.3</td>
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<td>40-59</td>
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<td>39.4</td>
<td>27.1</td>
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<tr>
<td>60-79</td>
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<td>20.1</td>
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<tr>
<td>80-98.3</td>
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<td>1.0</td>
<td>22.5</td>
<td>7.0</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
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</tbody>
</table>

<sup>a</sup> Low potential = Coastal, Eastern and Western lowlands and Marginal rain shadow  
<sup>b</sup> Medium potential = Central and Western highlands and Western Transitional  
<sup>c</sup> High potential = High potential maize zone

*Source: Kibaara (2005)*
Efficiency of Smallholder Maize Production (cont)

- Wide differences in maize yield across technical efficiency ranges
- Yield lowest in low potential and highest in high potential zone

<table>
<thead>
<tr>
<th>Range of TE in Percent</th>
<th>Low&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Medium&lt;sup&gt;b&lt;/sup&gt;</th>
<th>High&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Overall</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>maize yield (bags/acre)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&lt;20</td>
<td>1.3</td>
<td>1.8</td>
<td>1.7</td>
<td>1.5</td>
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<tr>
<td>20-39</td>
<td>2.8</td>
<td>3.9</td>
<td>5.0</td>
<td>3.5</td>
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<td>40-59</td>
<td>5.4</td>
<td>7.8</td>
<td>9.0</td>
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<td>60-79</td>
<td>11.8</td>
<td>13.7</td>
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<tr>
<td>80-98.3</td>
<td>-</td>
<td>16.4</td>
<td>21.6</td>
<td>21.3</td>
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<tr>
<td>Total</td>
<td>4.3</td>
<td>7.4</td>
<td>13.3</td>
<td>8.3</td>
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</table>

<sup>a</sup> Low potential = Coastal, Eastern and Western lowlands and Marginal rain shadow  
<sup>b</sup> Medium potential = Central and Western highlands and Western Transitional  
<sup>c</sup> High potential = High potential maize zone

*Source: Kibaara (2005)*
Efficiency of Smallholder Maize Production (cont)

- Factors that increase efficiency in maize production (Kibaara, 2005)
  - Use of improved maize varieties
  - Use of fertilizer
  - Use of credit – provides resources for acquisition of inputs
  - Being in high potential areas (high rainfall areas)
  - Increased level of education (management ability)
  - Being younger
HOW TO IMPROVE EFFICIENCY IN SMALLHOLDER MAIZE PRODUCTION
How to improve efficiency in maize production

Potential priority areas:

1. More widespread and intensive use of modern farming technologies
   - Fertilizer
   - Seed
2. Improved extension effort
3. Well-functioning input and output markets
4. Irrigation
1. More widespread and intensive use of modern farming technologies

### Fertilizer

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Coastal Lowlands</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Eastern Lowlands</td>
<td>27</td>
<td>25</td>
<td>47</td>
<td>43</td>
</tr>
<tr>
<td>Western Lowlands</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Western Transitional</td>
<td>41</td>
<td>70</td>
<td>71</td>
<td>81</td>
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<tr>
<td>High-Pot. Maize Zone</td>
<td>84</td>
<td>90</td>
<td>87</td>
<td>91</td>
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<tr>
<td>Western Highlands</td>
<td>75</td>
<td>91</td>
<td>91</td>
<td>95</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>90</td>
<td>90</td>
<td>91</td>
<td>93</td>
</tr>
<tr>
<td>Marginal Rain Shadow</td>
<td>6</td>
<td>12</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total Sample</strong></td>
<td><strong>58</strong></td>
<td><strong>64</strong></td>
<td><strong>66</strong></td>
<td><strong>70</strong></td>
</tr>
</tbody>
</table>

*Source: Tegemeo Institute, Household Surveys (1997-2007)*

- Increased number of households using fertilizer overtime; positive impact on maize productivity growth
1. More widespread and intensive use of modern farming technologies (cont)

**Fertilizer**

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Dose rate (kgs/acre) on fertilized maize fields</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coastal Lowlands</td>
<td>11</td>
<td>5</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Eastern Lowlands</td>
<td>10</td>
<td>18</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Western Lowlands</td>
<td>24</td>
<td>14</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Western Transitional</td>
<td>54</td>
<td>48</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td>High-Pot. Maize Zone</td>
<td>65</td>
<td>67</td>
<td>74</td>
<td>75</td>
</tr>
<tr>
<td>Western Highlands</td>
<td>31</td>
<td>36</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>68</td>
<td>64</td>
<td>64</td>
<td>58</td>
</tr>
<tr>
<td>Marginal Rain Shadow</td>
<td>12</td>
<td>15</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td><strong>National sample</strong></td>
<td><strong>56</strong></td>
<td><strong>55</strong></td>
<td><strong>60</strong></td>
<td><strong>59</strong></td>
</tr>
</tbody>
</table>

*Source: Tegemeo Institute, Household Surveys (1997-2007)*

- But application rate has stagnated overtime; affordability and knowledge on application rate are a concern
1. More widespread and intensive use of modern farming technologies (cont)

**Fertilizer**

<table>
<thead>
<tr>
<th>Reasons for not using (% of hh)</th>
<th>1997</th>
<th>2007</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not Use fertilizer (% of hh)</td>
<td>36.6</td>
<td>24.1</td>
<td>30.3</td>
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<tr>
<td>Unaffordable</td>
<td>47.6</td>
<td>44.8</td>
<td>51.5</td>
</tr>
<tr>
<td>Unavailable</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>No need to use</td>
<td>10.6</td>
<td>21.0</td>
<td>32.8</td>
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<tr>
<td>Uses organic fertilizer</td>
<td>21.3</td>
<td>24.7</td>
<td>11.9</td>
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<tr>
<td>Others reasons</td>
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<td>3.0</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Tegemeo Institute, Household Surveys (1997-2010)

- Affordability most important reason for not using fertilizer
- Lack of information may be a hindrance to use
1. More widespread and intensive use of modern farming technologies (cont)

**Fertilizer**

- Need for fertilizer cost reducing measures – KV 2030
  - Infrastructure improvement - reduce transportation cost
    - Rail transport
    - Rural feeder roads
  - Local manufacturing – feasibility study on

- Government support to poor and vulnerable

- Targeted subsidy (E.g NAAIAP)
  - Need for complementary extension advice
  - Emphasize farmer empowerment to sustain input use beyond subsidy regime
1. More widespread and intensive use of modern farming technologies (cont)

**Seed**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% of hhs planting high yielding maize varieties</td>
<td>70</td>
<td>69</td>
<td>69</td>
<td>74</td>
</tr>
<tr>
<td>% of hhs using fertilizer plus hybrid maize seed</td>
<td>51</td>
<td>55</td>
<td>57</td>
<td>61</td>
</tr>
<tr>
<td>Distance to seller of hybrid maize seed</td>
<td>N/A</td>
<td>5.6</td>
<td>3.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: Tegemeo Institute, Household Surveys (1997-2007)

- Increased number of households planted improved maize varieties
- Proximity to certified maize seed sellers improved
- But the average age of maize hybrids grown in Kenya is old (about 18 years overall in 2010), although the numbers planted increased
2. Improved extension effort

- Extension key to absorption and proper use of modern technologies
- But public and private extension generally not adequate

Public extension
  - Inadequate staffing
  - Demand-driven approach; access to information an issue among many farmers

Private extension
  - Generally skewed towards high potential regions
  - High-value crops
  - Scope limited

- Government need to work more in serving disadvantaged regions
- Partnership option (as in the NASEP)
3. Well-functioning input and output markets

- Without well-functioning markets, productivity growth unlikely
  - Input markets - timely availability and affordability of quality inputs
  - Output markets – certainty in accessing market outlets and obtaining rewarding prices

> Greater support to NARIs for generating improved varieties and breeds, and crop management techniques

> Invest in rural feeder road infrastructure and rehabilitate railway system

> Support programs that work with farmers to improve their crop husbandry, access to information and marketing skills

> Invest in market physical infrastructure
4. Irrigation

- Increasing episodes of depressed rainfall affecting maize yield and production
- Investment in irrigation
  - More land under irrigation
  - Water harvesting and storage
Thank You


References (cont)


