
Executive summary

Wheat is one of the key staples with fast growing demand in Africa. The growth in consumption is fueled by income growth and urbanization and associated dietary changes. By 2025, about 700 million people (more than half of the African population) are projected to live in urban areas. Wheat currently accounts for about 30% of the cereal calories and 15% of all food calorie supplies. However, sub-Saharan countries and Africa as a whole respectively produce only about 30% and 40% of their domestic requirements. This has led to heavy dependence on imports, during 2007-2009; Africa’s average annual wheat import reached more than 31 million tons costing about 10 billion dollars. Soaring international food and energy prices and the resulting volatility in markets is alarming many African policy makers and has made the region highly vulnerable to global market and supply shocks. However, the study conducted jointly by CIMMYT and IFPRI for 12 SSA countries indicates that considerable potential exists for profitable and competitive wheat production in sub-Saharan Africa. These countries are currently using less than 10% of the profitable wheat production potential. Unleashing this potential for import substitution and national agricultural development and food security will require substantial changes in attitudes, policy and donor support for adapting farming systems, empowering African farmers and developing value chains for seeds, input supply and output markets. The priority should be on utilizing existing varieties and technologies in most suitable agro-ecologies through improvements in seed supply, agricultural extension and farmer education and marketing infrastructure to reduce costs and ensuring competitiveness of domestic producers.

Introduction

The wheat economy of Africa has been characterized by a widening gap between demand and domestic production amidst increased price levels and volatility, supply uncertainty due to changes in climate and trade policies, and the global economic downturn and tightening foreign exchange earnings. Given the economic and demographic changes occurring in Africa, the demand for wheat has been rapidly growing and wheat import dependency has increased the vulnerability of African countries to wheat supply and price shocks. According to FAO, during 2007-2009, African countries annually imported about 31 million tons of wheat worth about 10 billion dollars (Table 1). Many previous analysts have concluded that SS Africa cannot produce wheat competitively mainly due to lack of suitable agro-ecologies and high costs of production. With increasing urbanization and rising food prices, wheat is a very strategic commodity for peace and security in the region and African policymakers face the dilemma of supporting domestic producers and subsidizing imports for ensuring adequate supplies at affordable prices. As the gap grows, Africa today therefore stands at an important junction to carefully evaluate the potential for import substitution reducing dependency on less predictable and volatile world food markets. In order to evaluate these opportunities, CIMMYT and IFPRI undertook a joint strategic analysis that aimed to inform the wheat food security strategy in SS Africa.
by exploring the potential to meet growing demands through profitable domestic production that is competitive to imports. This policy brief highlights the result of this initial comprehensive assessment focusing on 12 selected Sub-Saharan Africa (SSA) countries (Angola, Burundi, Ethiopia, Kenya, Madagascar, Mozambique, Rwanda Tanzania, DRC, Uganda, Zambia and Zimbabwe). The findings may however have Africa-wide implications and for other wheat import dependent countries with potential for import substitution.

### Wheat production and consumption in Africa

In SS Africa, wheat production is characterized by diverse production systems, production practices and constraints. This suggests that generalization might be difficult and different strategies need to be considered to exploit the wheat production potential.

- The overwhelming majority of the wheat cultivars grown are spring bread wheat types, although some spring durum wheat is grown in Ethiopia and facultative winter types are grown in the temperate environments of Southern Africa.

- There are two major contrasting wheat production systems in Eastern and Southern Africa - rainfed highlands and winter (dry season) irrigated systems.

The wheat production-consumption gap in Africa has expanded over the last several decades (Figure 1) while production has either declined or stagnated over time. Similarly, the wheat self-sufficiency ratio for Africa has been declining over time from 46% in 2004-2006 to 40% in 2007-2009.

The per capita wheat consumption demand in Africa has grown from about 25 kg/year in the early 1960s to over 50 kg/year in recent years (Table 1 and Figure 2). However, per capita production remained between 20 and 25 kg, depicting a widening gap in domestic supply and consumption over past half century.

As a result, Africa has registered significant growth in wheat trade and has become one of the largest wheat importers accounting for 24% of the global trade in recent years (Figure 3). The import burden has reached over US$ 5 billion for SSA and US$10 billion for Africa as a whole. However, both nominal and real international wheat prices have soared recently with major spikes in 2007-08 and 2011 (Figure 4). As reported in the recent World Bank Food Price Watch, grain prices have been generally

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**Table 1: Key statistics on wheat production, consumption and trade in Africa (2007-2009)**

<table>
<thead>
<tr>
<th>Region</th>
<th>Total production (million tons)</th>
<th>Per capita production (kg/year)</th>
<th>Total consumption (million tons)</th>
<th>Per capita consumption (kg/year)</th>
<th>Quantity of import (million tons)</th>
<th>Value of import (billion dollars)</th>
<th>Wheat self-sufficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Africa</td>
<td>3.25</td>
<td>10.6</td>
<td>7.1</td>
<td>23.1</td>
<td>3.9</td>
<td>1.2</td>
<td>46.1</td>
</tr>
<tr>
<td>Middle Africa</td>
<td>0.02</td>
<td>0.2</td>
<td>0.9</td>
<td>7.2</td>
<td>0.8</td>
<td>0.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Western Africa</td>
<td>0.07</td>
<td>0.2</td>
<td>6.0</td>
<td>20.8</td>
<td>5.9</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Northern Africa</td>
<td>16.10</td>
<td>79.5</td>
<td>35.2</td>
<td>173.8</td>
<td>19.1</td>
<td>6.3</td>
<td>45.8</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>2.02</td>
<td>35.5</td>
<td>3.8</td>
<td>67.8</td>
<td>1.9</td>
<td>0.4</td>
<td>53.3</td>
</tr>
<tr>
<td>Africa</td>
<td>21.50</td>
<td>22.0</td>
<td>52.6</td>
<td>53.9</td>
<td>31.3</td>
<td>10.1</td>
<td>40.7</td>
</tr>
</tbody>
</table>

Source: Based on FAOSTAT databases.
increasing during 2012 – increasing by 18% between April and July with wheat prices increasing by 30%\textsuperscript{1}. These price increases pose greater challenges for African governments who will have to cut scarce resources from alternative investments to import growing quantities of wheat demanded by consumers to maintain national food security. The question remains whether African governments could consider expanding domestic production to diversify against risks, reduce import dependence, save scarce foreign exchange, and create growth and employment opportunities at home. This can only make economic sense when domestic production is profitable and competitive with imports.

\textbf{Approach and methods}

A combination of research methods were used to assess the potential for profitable rainfed wheat production in sub-Saharan Africa. First, a review of relevant literature and analyses of secondary data were made to understand the dynamics of the African wheat economy. Second, twelve countries were selected based on analysis of biophysical and agro-climatic suitability for wheat production. The biophysical and economic production potential of the selected 12 countries was then evaluated as follows:

- **GIS analysis.** A number of biophysical suitability mapping approaches were evaluated and utilized to delineate suitable agro-ecologies as a basis for running the crop growth model.

- **Crop growth simulation.** The wheat plant growth parameters for selected varieties identified as suitable for wheat growing environments were first calibrated using actual experimental data to ensure that the models will approximate actual yields. CERES-Wheat model in the DSSAT (Decision Support System for Agro-technology Transfer) was then used to estimate wheat yield responses at the pixel level (10 km\textsuperscript{2} grid) under rain-fed conditions and three different levels of intensification (low, medium and high of fertilizer use).
Fertilizer and grain transport cost modelling. Spatial analysis using road network and land cover data on GIS estimated the pixel-specific unit transport cost across the region, and these data were used to estimate farm-gate price of fertilizer and the cost of transporting wheat product from each pixel to the main market of each country.

Economic profitability and competitiveness analysis. The simulated wheat yield response data was integrated with economic data (production costs and output prices and marketing costs) to analyze the economic profitability of wheat under different intensification levels. The site-specific economic profitability was measured using pixel level net economic returns derived by deducting variable costs (labor, seed, fertilizer and traction power) from gross farm returns obtained by multiplying wheat yield by pixel level import parity prices. If pixel level production is profitable using imported fertilizer and import parity prices, wheat production is considered profitable and competitive to imports. The national potential is then estimated at different levels of profitability and competitiveness (low, medium and high) by aggregating returns from pixel level simulations.

Sensitivity analysis. The robustness of the estimated potential was then evaluated against plausible changes in wheat prices, fertilizer prices, grain yields (e.g. due to pest and disease pressure), marketing costs and climate change.

Results

The results of the simulation analysis provide strong evidence for the economic profitability and competitiveness of domestic wheat production for the selected SS African countries.

- The crop simulation model showed a positive and significant yield response to fertilizer application (Figure 5). Simulated yields varied within and across countries depending on agro-ecological conditions, but were generally highest in the Eastern and Central African highlands and mid-altitude growing regions. At medium levels of intensification, wheat yields averaged between 1.2 and 3.5 tons per hectare, but also reached about 4 tons per hectare in the highland temperate agro-ecologies.

- The net economic return within each country also varied across agro-ecologies and growing

![Figure 5: The average pixel level estimated wheat yield by level of intensification](image)
areas depending on simulated yields, landed farm-level cost of fertilizer and transport costs as estimated based on distance to major consumption centers. The profitability and competitiveness of domestic production also varied across countries depending on growing conditions, costs of production, the import parity price of wheat and infrastructure conditions and marketing costs. The average net economic returns (NER) were generally highest in the most suitable highland agro-ecologies of Eastern and Central Africa for rainfed wheat production Figure 6).

- The percentages of pixels with positive NER at the medium level of intensification were about 20% in Mozambique, 30% in Angola, 58% in Zimbabwe to 85% in Ethiopia, 92% in Kenya, 96% in Rwanda, and 100% in Burundi and Uganda (Figure 7). This shows that each of the countries have a certain amount of land potentially suitable and competitive for wheat production. This was the case even for low-input (zero fertilizer) rainfed wheat production, but this improved with investments in fertilizer and level of intensification.

- Using the 2011 constant prices, at a low level of intensification (zero fertilizer use), the profitable area ranged from 15% (Mozambique), 22% (Angola), 35% (Zimbabwe) to about 100% (in Burundi and Uganda). Competitiveness generally increases with fertilizer use and intensification but the increasing cost of production and declining marginal returns indicated decreasing returns to level of intensification.

- Under medium levels of intensification, the highly profitable land area (NER>US$200/ha) potentially suitable for wheat production (in million ha) was 0.3 (Mozambique and Burundi), 0.4 (Rwanda), 0.5 (Uganda), 1.7 (Kenya), 2.0 (Zimbabwe), 2.3 (Zambia), 3.0 (Tanzania), 3.2 (Madagascar), 4.3 (Ethiopia). These estimated most likely inflated because of lack of use data and related difficulties of unsuitable areas (e.g. slopes, grazing settlements, etc) within a pixel. But the of agro-ecological potential in each for wheat production is not in 5.

- However, how much of this potentially profitable area could be competitively allocated to wheat production for import substitution depends on whether these lands are already being used for other crops (as in many densely populated areas), relative profitability of wheat with other enterprises, and government support and investments to promote wheat production through provision of extension, input supply and market development.

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**Figure 6:** The estimated net economic returns (NER, US$/ha) from wheat production

**Figure 7:** The percentage of pixels with positive net economic return from rainfed wheat production by level of intensification

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Sensitivity analysis

The estimated profitability and competitiveness of wheat production and the potentially suitable area are sensitive to certain biophysical and socioeconomic changes such as changes in wheat yields, wheat prices, fertilizer costs and marketing costs, but significant areas remain competitive in each country to plausible changes:

• Increasing wheat yields and wheat prices and decreasing fertilizer costs and domestic marketing costs increased the profitability of domestic wheat production significantly. Overall, the estimated wheat production remained profitable and competitive within 25% of the increase or decrease in the baseline values of the key parameters.

• Climate change predictions evaluated indicate that the profitable area would not be much affected. The impact of climate change considering temperatures and rainfall seems to be marginal for many of the high potential areas, and the negative effects almost disappear when one considers the CO$_2$ fertilization effect.

Policy recommendations

The results from this study indicate that potential exists for competitive and profitable rainfed wheat production in Africa which can contribute toward reducing dependence on imports. The potential varies within and across countries depending on agro-ecological and socioeconomic conditions that determine the cost of production and marketing. However, the key question remains whether African countries have the capacity and political will and determination to exploit this potential. Realizations of this potential will require several concrete actions to be taken on many fronts and in a coordinated way.

• Paradigm shift. It requires change in perceptions and a paradigm shift in development assistance to support wheat in Africa and significant changes in the wheat production and marketing practices—upgrading existing wheat value chains where wheat is already grown or developing new ones where wheat production can be promoted as an alternative to expensive imports.

• Understanding constraints that limit wheat production where the potential is high. A closer analysis of the farming systems, alternative crops, market conditions, land and labor issues, food aid, institutional and policy constraints that may undermine farmers’ incentives to grow wheat.

• Evaluate alternative strategies for expansion. These options may vary across countries and regions, but governments may consider a combination of the following:
  
  ▪ Land surplus economies. Some of the countries like Mozambique, Zambia, Angola, Zimbabwe, Madagascar and Tanzania with current low population density may consider putting new land under wheat cultivation. This will however require complementary investments in roads, irrigation, storage and marketing systems. Care should as well be exercised to ensure that such expansion will not cause undesirable environmental and social tradeoffs.

  ▪ Land constrained economies: Countries in eastern and central Africa such as densely populated highland regions of Rwanda, Burundi, Kenya, Uganda and parts of Tanzania will have to consider integrating wheat into existing farming systems without necessarily crowding out other profitable crops and livelihood options for the poor. Further investigation is required on how this may be done within the existing farming systems and to identify the enabling conditions.

  ▪ Ethiopian highlands: In Ethiopia, wheat is already widely grown and the potential for increasing production may primarily consider intensification on existing lands through application of modern varieties, fertilizer use and pest and disease control systems. High yielding, stem and yellow rust resistant varieties will be useful options. Limited expansion of wheat into new areas for commercial production may also be possible especially in areas with good market access with proximity to urban centers.
• **Policy support for building domestic production capacity.** In many areas where wheat is not currently grown, further expansion will only be economically attractive if wheat can be grown as a commercial crop. This will require significant improvements in provision of extension, credit services, production and supply of seed using existing varieties, strengthening input supply systems, support for mechanization of production, and investment in marketing efficiency and reducing transaction costs. This will also require rationalizing imports and removal of import subsides and shifting from ‘food aid’ to ‘cash aid’ that will allow purchasing locally (e.g. purchase for progress – P4P – operated by WFP).

• **Development of wheat varieties and technologies:** While the initial strategy should be utilization of existing ‘on-the shelf’ varieties, sustainable and profitable production of wheat in Africa in the long term will require investments in wheat research and development. This will increase capacity development at national and regional levels to develop and adapt varieties suitable for different agro-ecological zones. This will require significant support from donors and collaboration with the CGIAR institutions working in Africa.

• **Determine the composition of wheat imports, quality preferences and requirements.** The foremost challenge of free trade in wheat is competing with lower priced, higher quality imports of grain and wheat-based products. The success of local wheat production will depend on the capacity of local producers and processors to consistently supply the right quality and quantity of wheat for end-markets and end-users at competitive prices. Further research is needed to identify the tastes and preferences for consumers of wheat and wheat-based products, and assess the capacity of local wheat processing and food manufacturing in order to identify constraints and areas where upgrading is needed.

This study did not look at irrigated wheat, though we recognize the great potential; e.g. in Zambia, Zimbabwe, Nigeria or Mali to name a few countries. Some of the highest spring wheat yields world-wide have been reported for irrigated wheat in SSA and the options for irrigated wheat production warrant separate analysis.

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