



# MAFAP SPAANA

Monitoring African Food and Agricultural Policies  
Suivi des politiques agricoles et alimentaires en Afrique

## ANALYSIS OF INCENTIVES AND DISINCENTIVES FOR SORGHUM IN KENYA

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FEBRUARY 2013



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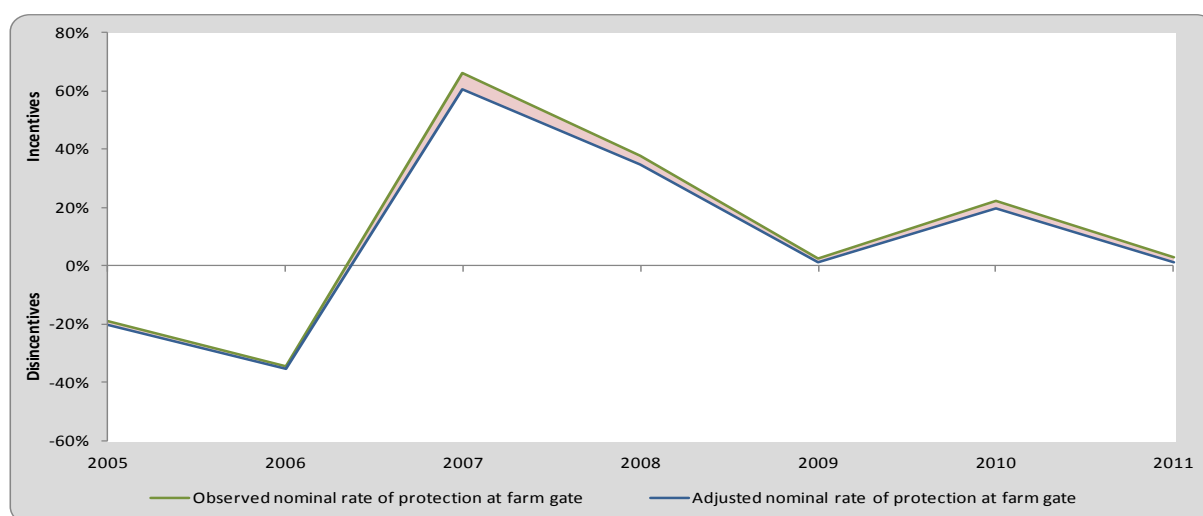
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## SUMMARY OF THE NOTE

Product: Sorghum  
 Period analyzed: 2005 – 2011  
 Trade status: Import

- Sorghum is thinly traded due to low production volumes and poor marketing channels; an estimated 30% of domestic production is marketed.
- Between 2009 and 2011, there were profound fluctuations in both imports and exports due to a regional drought and food shortage. A large share of traded volumes in these years may have been food aid for Kenya and other countries within the region.
- With the exception of imports from the United States and European countries in certain years, Kenya usually imports sorghum from neighboring countries, such as Uganda and Tanzania.
- Sorghum imports from outside the East African Community (EAC) and Common Market for Eastern and Southern Africa (COMESA) regions are subject to a 25% tariff.
- In recent years, the Kenya Agricultural Research Institute (KARI), in collaboration with East African Breweries Ltd. (EABL), has been promoting the use of high quality sorghum varieties, such as gadam, in beer production. This development has spurred renewed interest in the commercial production of sorghum, as it offers farmers prospects for higher returns.



The observed Nominal Rate of Protection (NRP, green line) in the graph above indicates market price incentives and disincentives for producers varied considerably throughout the period analyzed. The adjusted NRP (blue line) captures the effect of market inefficiencies along the value chain. The area in red shows the costs that these inefficiencies represent for producers.

- NRPs were close to zero or negative in years when sorghum was imported from the United States or Europe, indicating that the 25% tariff on imports from outside the EAC and COMESA regions was not effective in keeping prices high for producers, possibly because it was waived during periods of severe drought.
- NRPs were positive in years when sorghum was imported from the region, indicating that producers received market price incentives. This was largely due to high domestic prices relative to regional import prices, which may have resulted from a decline in domestic

sorghum production during post-election instability in 2007/2008, as well as a regional drought in 2009/2010.

- The results suggest that most of the variability in price incentives and disincentives throughout the period analyzed was due to production shortages, shifts in trade patterns and possibly even food aid subsidies and the removal of import tariffs in certain years.
- Finally, market price inefficiencies due to taxes, bribes and other non-tariff barriers reduce price incentives for producers, though these opportunity costs were relatively marginal, amounting to only about 2% of the adjusted reference price at farm gate.

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## 1. PURPOSE OF THE NOTE

This technical note aims to describe the market incentives and disincentives for sorghum in Kenya. The note is a technical document and serves as input for the MAFAP Country Report.

For this purpose, yearly averages of farm gate and wholesale prices are compared with reference prices calculated on the basis of the price of the commodity in the international market. The price gaps between the reference prices and the prices along the value chain indicate to which extent incentives (positive gaps) or disincentives (negative gaps) are present at the farm gate and wholesale level. In relative terms, the price gaps are expressed as Nominal Rates of Protection (NRPs). These key indicators are used by MAFAP to highlight the effects of policy and Market Development Gaps (MDGs) on prices.

The note starts with a brief review of the commodity's production and consumption as well as trade and policies affecting the commodity. It also provides a detailed description of how the key components of the price analysis were obtained. Using this data, the MAFAP indicators were then calculated and interpreted in light of existing policies and market characteristics. The analysis is commodity and country specific and covers the period 2005-2011. The indicators were calculated using available data from different sources for this period.

The results of this analysis can be used by stakeholders involved in policy-making for the food and agricultural sector. They can also serve as input for evidence-based policy dialogue at the country or regional level.

This technical note is not to be interpreted as an analysis of the value chain or detailed description of production, consumption or trade patterns. All information related to these areas is presented merely to provide background on the commodity under review, help understand major trends and facilitate the interpretation of the indicators.

All information is preliminary and still subject to review and validation.

## 2. COMMODITY CONTEXT

### PRODUCTION

Sorghum is a staple food crop for many low-income households in Kenya. It is typically grown by small-scale, resource-poor farmers and is mainly used for home consumption. As the only cereal species indigenous to Kenya, sorghum is produced throughout much of the country, even in areas with low agricultural potential. Sorghum can grow anywhere from sea level to 2,500 meters above sea level and requires a minimum rainfall of 250 mm per year and a minimum temperature of 10°C (Chemonics, 2010).

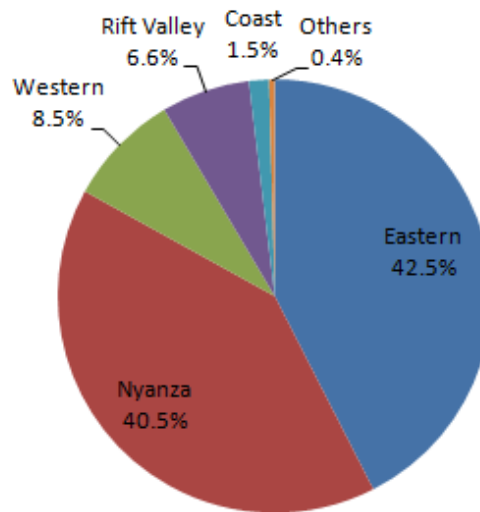
Most sorghum production is concentrated in Kenya’s southwestern and south-central districts (see Figure 1), namely within the Eastern, Nyanza, Western and Rift Valley provinces, which accounted for about 43, 41, 9 and 7 percent of Kenya’s total sorghum production in 2011 (see Figure 2). Collectively, these provinces produce 99 percent of the country’s sorghum (MoA-ERA, 2012).

Figure 1: Major Sorghum Producing Districts in Kenya, 2010



Source: Chemonics, 2010

**Figure 2: Share of Total Sorghum Production by Province, 2011**



Source: MoA-ERA, 2012

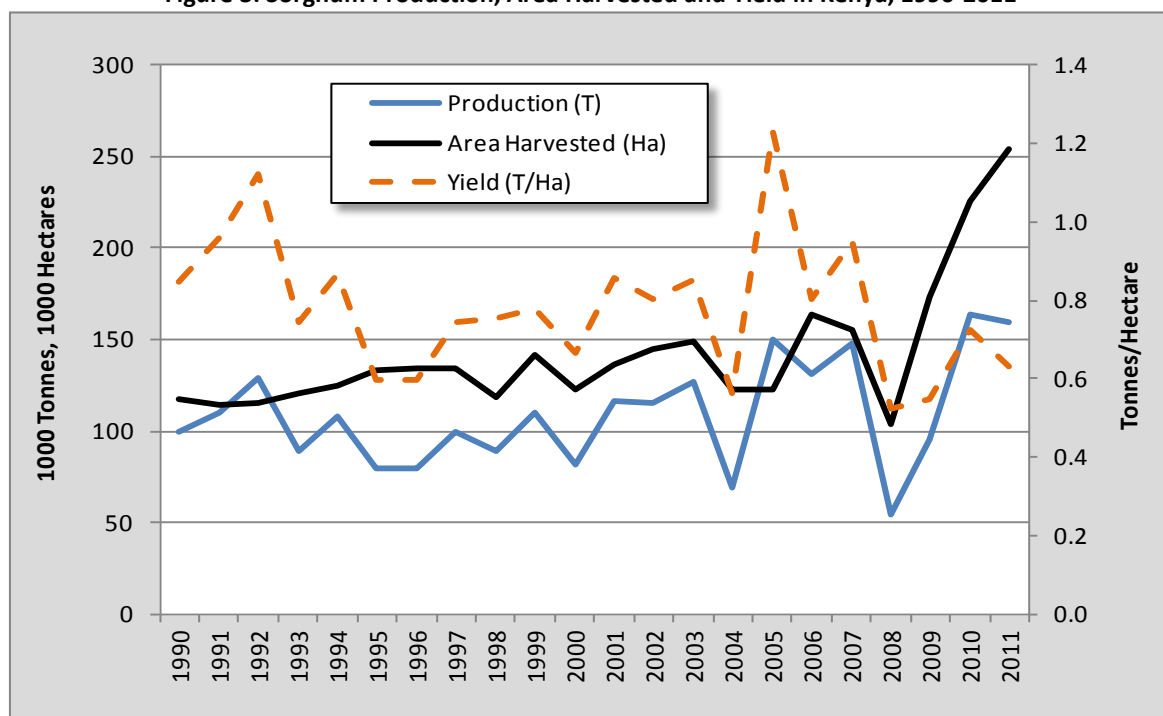
Figure 3 shows the national trend in sorghum production, area harvested and yield from 1990 to 2011. Sorghum production varied considerably between years due to changes in yield and area harvested. Average annual sorghum production during this period was about 109,414 tonnes, while the average annual growth in production was about 10 percent.

As illustrated, sorghum production has been the most volatile in recent years, reaching its lowest point in 2008. This dramatic decline was strongly correlated with a reduction in yield and in total area planted to sorghum, resulting mainly from political instability following Kenya's December 2007 election (Chemonics, 2010). Between 2008 and 2010, sorghum production recovered to similar levels that existed in 2007. As shown, most of this growth was driven by increases in area harvested, which was largely due to the promotion of sorghum as a drought resistant crop in the Arid and Semi-Arid Lands (ASALs) as well as attractive prices from increased consumption (MoA-ERA, 2011). Growth in sorghum production during this period was also driven, though to a much lesser extent, by minor improvements in productivity. In 2011, however, a decrease in yield caused production to stagnate, even though the total area planted to sorghum continued to grow. This reduction in productivity was mainly caused by the early cessation of 2011 short rains, which hindered production in the Eastern Province and parts of the Coast Province (MoA, 2012a).

As illustrated in Figure 3, sorghum yields have shown little consistent improvement over the period analyzed, varying significantly from year to year. In 2005, sorghum yields peaked at 1.2 tonnes per hectare, but decreased to only 0.6 tonnes per hectare in 2011. The average yield from 1990 to 2011 remained low at 0.8 tonnes per hectare, despite the development of new seed varieties with the potential to yield 2 to 5 tonnes per hectare.



**Figure 3: Sorghum Production, Area Harvested and Yield in Kenya, 1990-2011**



Source: FAOSTAT, 2012 (years 1990-2004); MoA-ERA, 2009 & 2012 (years 2005-2011)

## CONSUMPTION/UTILIZATION

Figure 4a shows that total sorghum consumption in Kenya increased gradually from 2005 to 2007, but decreased dramatically between 2007 and 2008 due to post-election instability and a concomitant decline in sorghum production. Since 2008, total sorghum consumption in Kenya increased once again, leveling off at about 81,000 tonnes (MoA-ERA, 2009 & 2011).

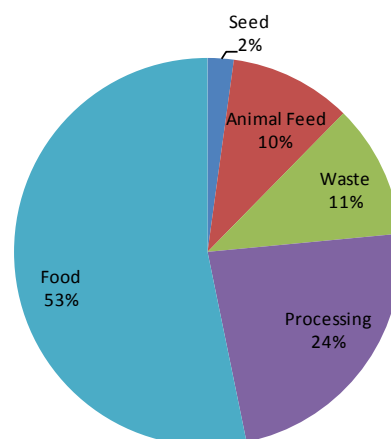
Most sorghum grain in Kenya is consumed by rural households, who typically grind it into flour to make porridge, known as ‘ugali’. Some sorghum grain is also processed into flour by commercial mills and sold in urban markets. In many cases, sorghum flour is used to enrich cassava flour before it is packaged and sold to consumers (Chemonics, 2010). The by-products from sorghum processing are typically used for animal feed production.

In recent years, there has been growing demand for sorghum within the brewing industry for use in beer production. Figure 4b shows that on average, 53 percent of the total sorghum supply in Kenya each year is consumed as food in the form of grain or flour, while 24 percent is processed to make other commodities (e.g. beer), 11 percent goes to waste, 10 percent goes to the animal feed industry and 2 percent is used as seed for planting (FAOSTAT, 2012).

**Figure 4a: Total Consumption, 2005-2010**



**Figure 4b: Average Disposition, 2005-2009**



Source: MoA-ERA, 2009 & 2011; FAOSTAT, 2012

## MARKETING AND TRADE

Sorghum trade in Kenya is generally limited due to low production volumes and poor marketing channels. Most farmers produce enough sorghum to meet their domestic requirements, with little surplus to sell (Ochieng, 2011). In fact, it has been estimated that only 30 percent of domestic sorghum production is actually marketed (NU, 2006).

Kenya is generally self-sufficient in sorghum production, but must import considerable quantities in some years (Chemonics, 2010). As illustrated in Figure 5 and detailed in Table 1, the total volume of sorghum internationally traded in Kenya remained low until years 2009-2011, which show profound fluctuations in both imports and exports.

Table 1 also shows that Kenya was a net importer of sorghum in all years, except in 2010. In this particular year, Kenya exported 49,709 tonnes of sorghum mainly to Somalia (23,852 tonnes) and Sudan (20,133 tonnes), since both countries faced severe drought conditions that necessitated food imports. However, Kenya's unusually high volume of imports in 2009, primarily from the United States, suggests that most exports in 2010 may have actually been food aid shipments received in the previous year for redistribution to neighboring countries in crisis. Although the volume of imports increased once again in 2011, most were from countries within the region.

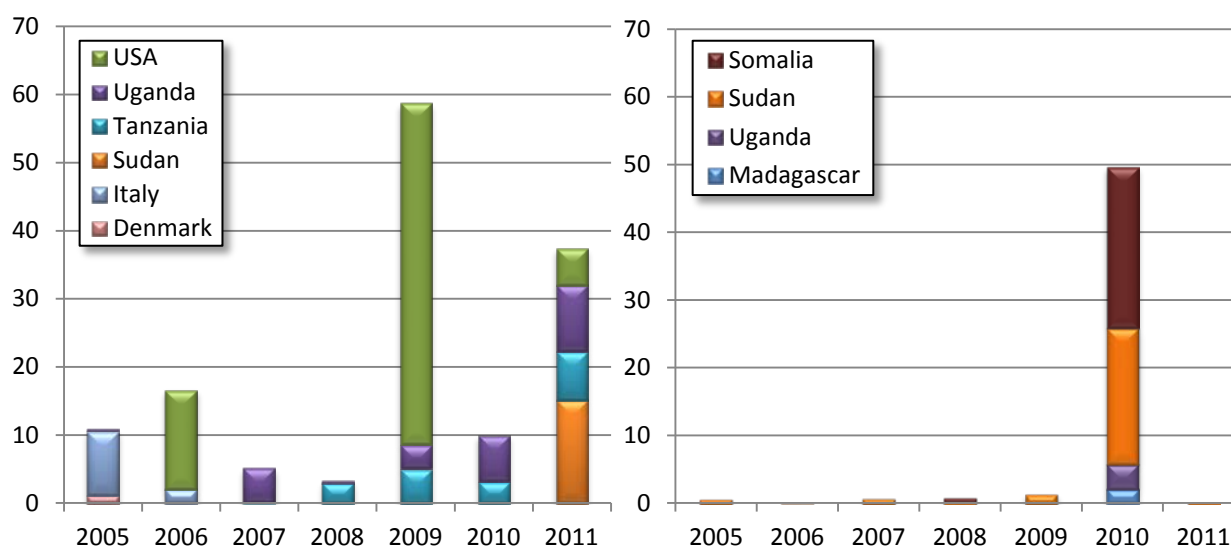
With the exception of irregular imports from the United States and European countries, Figure 5 indicates that Kenya generally imports sorghum from neighboring countries, such as Uganda, Tanzania and, to a lesser extent, Sudan.

**Table 1: Sorghum Trade and Production in Kenya, 2005-2011**

	Unit	2005	2006	2007	2008	2009	2010	2011
Production	T	150,127	131,188	147,365	54,262	94,955	164,066	159,877
Imports	T	10,948	16,691	5,105	3,301	58,822	10,035	37,613
Exports	T	734	97	919	892	1,503	49,709	276
Trade Balance	T	-10,213	-16,594	-4,186	-2,409	-57,320	39,674	-37,337
Self-Sufficiency Ratio	%	94%	89%	97%	96%	62%	132%	81%

Source: MoA-ERA, 2009 & 2012; UN Comtrade, 2010; GTA, 2012

**Figure 5: Kenya's Sorghum Imports (Left) and Exports (Right) by Trade Partner, 2005-2011 (1000 tonnes)**



Source: UN Comtrade, 2010; GTA, 2012

Though sorghum trade is limited in Kenya, this is likely to change in the near future. Due to increased health concerns and awareness, the use of sorghum products has seen a gradual increase, as reflected by the quantity and range of processed sorghum products sold in local supermarkets. Sorghum flour is in great demand and is likely to be the future for the sorghum industry (Chemonics, 2010).

With proper packaging, the sorghum flour market could be expanded to larger retail outlets and export markets (Chemonics, 2010). Furthermore, the Kenya Agricultural Research Institute (KARI) in collaboration with East African Breweries Ltd. (EABL), one of the country's leading brewers, is promoting the use of higher quality sorghum varieties, such as gadam, to supplement barley in beer production (Ochieng, 2011; MoA-ERA, 2011). This recent development has spurred renewed interest in the commercial production of sorghum, as it offers farmers prospects for higher returns.

## DESCRIPTION OF THE VALUE CHAIN AND PROCESSING

As shown in Figure 6, the sorghum value chain includes several key agents, such as producers, middlemen and small traders, wholesalers, grain millers, retailers, consumers and exporters. Most sorghum grain is ground into flour at home for consumption within producing households, primarily for making porridge, known as 'ugali'. However, the small percentage (30 percent) of sorghum grain that is actually marketed is either sold directly to consumers (i.e. breweries, institutions and individuals) or to middlemen and small traders for wider distribution (Chemonics, 2010; Ochieng,

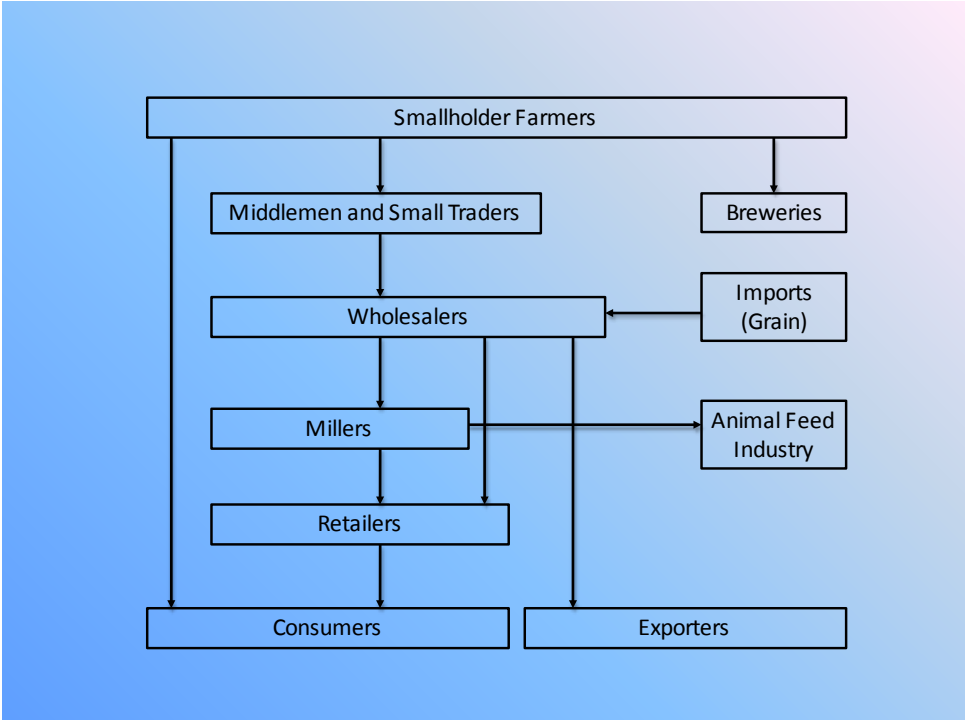
2011). Traders and middlemen generally bulk sorghum at local markets and transport it to wholesalers (Chemonics, 2010). Wholesalers sell directly to retailers, grain millers and exporters (Chemonics, 2010). The main markets for sorghum are Nyamakima and Gikomba in Nairobi, where there are about 150 wholesalers/retailers (Chemonics, 2010).

About 162 grain milling companies are operating in Kenya. Many produce sorghum flour, which is marketed through retailers, and sorghum by-products for the animal feed industry. Once processed, sorghum flour is sometimes mixed with cassava flour to enrich the flour product before it is sold, especially in urban areas. While sorghum is typically processed in small hammer mills in Gikomba, some is also processed in larger mills and packaged for sale in large-scale outlets (Chemonics, 2010).

Sorghum trading from production to retail is generally undertaken by individuals who work independently, rather than in organized groups. Traders at the Nyamakima and Gikomba markets have indicated that they would like to be organized into a group, which could lobby for their interests with the City Council. Traders in both markets are primarily concerned about the high council cess, harassment by the council, bribes during transport and poor access to credit and market information. They indicated that storage facilities, sale areas and loading/unloading facilities are inadequate and that there is a need for a larger staple foods market (Chemonics, 2010).

The beer industry has started to play a key role in the value chain for sorghum. This is largely due to the EABL’s increasing demand for higher quality sorghum varieties, such as gadam or gatiga, which has opened new marketing channels for producers. In fact, many producers have been contracted to grow sorghum for the EABL directly.

**Figure 6: Simplified Diagram of the Sorghum Value Chain in Kenya**



Source: Author’s own elaboration using Ochieng, 2011 and Chemonics, 2010

## **POLICY DECISIONS AND MEASURES**

Kenya's agricultural sector is guided by the Agricultural Sector Development Strategy (ASDS), 2010-2020, which aims to increase agricultural productivity, commercialization and competitiveness of the sector's commodities and enterprises to achieve national food security, increase exports for foreign exchange earnings and create employment opportunities. The ASDS classifies sorghum as one of Kenya's main food crops, along with maize, rice, wheat, potatoes, cassava, vegetables and beans, and puts forth several broad based strategies for increasing production, productivity and marketability of these crops. Before the ASDS was developed, agricultural policy mainly focused on cash crops rather than staple food crops, and even among staple food crops, more attention was paid to maize than other cereals.

### **Marketing and Price Policies**

The pricing and marketing for sorghum and all other cereal crops are liberalized, except for maize, which the government continues to regulate through the National Cereals and Produce Board (NCPB).

Despite the policy focus on staple food crops in recent years, many of these commodities, including sorghum, continue to face non-tariff trade barriers, such as roadblocks, multiple county cess and levies, which hamper their competitiveness both domestically and regionally (Chemonics, 2010).

### **International Trade Policy Measures**

Although no tariffs are levied on food crops traded among East African Community (EAC) and Common Market for Eastern and Southern Africa (COMESA) countries, tariffs are levied on some food crops traded with Southern Africa Development Community (SADC) countries and the rest of the world (Chemonics, 2010). In Kenya, sorghum imports from SADC countries and the rest of the world are subject to a 25 percent tariff.

### **Taxes or Subsidies to Production**

In response to the brewing industry's growing demand for sorghum, KARI and Kenya's Ministry of Agriculture have been promoting the production of higher quality gadam sorghum through the bulking and distribution of seeds to farmers under the Traditional High Value Crops (THVC) program (MoA, 2012a; MoA, 2012b). The THVC program, which aims to increase production and consumption of drought resistant crops in the country's ASALS, was initiated in the 2006/2007 financial year and is mainly implemented through government funding of Ksh 150 million per year. However, since the THVC program promotes the production and consumption of several alternative cereal and non-cereal crops, it is uncertain how much the government actually spent on bulking and distributing sorghum seeds each year and in what year or years these disbursements took place.

### **3. DATA REQUIREMENTS, DESCRIPTION AND CALCULATION OF INDICATORS**

To calculate the indicators needed to estimate market price incentives or disincentives for sorghum producers in Kenya, several types of data are needed. They were collected and are presented and explained hereafter.

#### **TRADE STATUS OF THE PRODUCT**

Kenya is not a major player in the international trade of sorghum and is generally self-sufficient in sorghum production. Only about 30 percent of domestic production is actually marketed and most is traded and consumed locally. As shown in Figure 5 and detailed in Table 1, Kenya was a net importer of sorghum throughout the entire period analyzed, with the exception of 2010. In this particular year, Kenya exported large volumes of sorghum to neighboring countries faced with severe drought conditions that necessitated food imports. However, since Kenya imported an unusually large volume of sorghum from the United States in 2009, it was assumed that most sorghum exports in 2010 were actually food aid shipments sent to Kenya in the previous year for re-export to neighboring countries in crisis. For this reason, Kenya was taken as a net importer of sorghum in all years under review.

With the exception of irregular imports from the United States and European countries in certain years, Kenya generally imports sorghum from countries within the region, such as Uganda, Tanzania and, to a lesser extent, Sudan (see Figure 5). Both imported and domestic sorghum is transported to wholesale markets, where it is sold to consumers, retailers and millers for processing. The main wholesale markets for sorghum are located in Nairobi (Chemonics, 2010).

Based on this general trade flow, Nairobi was taken as the wholesale market and the point of competition in this analysis, where domestic sorghum competes at world market prices. Busia was taken as the border, since it is one of Kenya's main trade partners, and the major production zone in western Kenya, which includes Busia, Kisumu, Nakuru, Eldoret and Kakamega, was taken as the farm gate in this analysis. Given that sorghum is mainly imported and traded at wholesale before it is processed, this analysis only focuses on the trade flow for unprocessed sorghum grain (HS 1007).

#### **BENCHMARK PRICES**

##### **Observed**

Since Kenya was considered a net importer of sorghum grain in all years, a unit value CIF price for sorghum imports was taken as the benchmark price (see Table 2). This price was calculated by dividing the total value of sorghum grain imports by the total quantity imported in each respective year. Import value and quantity data was obtained from Global Trade Atlas (GTA) for 2011 and from UN Comtrade for all other years analyzed. Furthermore, the unit value CIF price in 2007 is for imports from Tanzania only, since this was the most reliable data available. In all other years, the unit value CIF price is for imports from all trade partners.

**Table 2: Observed Unit Value Benchmark Prices, 2005-2011**

Unit	2005	2006	2007	2008	2009	2010	2011
USD/Tonne	260	327	161	270	415	292	377

Source: UN Comtrade, 2010; GTA, 2012

### Adjusted

No adjustments to benchmark prices were made.

## EXCHANGE RATES

### Observed

Average nominal exchange rates between the Kenya Shilling and the US Dollar were used in this analysis. The average rates for each year under review (shown in Table 5) were obtained from the World Bank's World Development Indicators database.

**Table 3: Nominal Exchange Rates in Kenya, 2005-2011**

Unit	2005	2006	2007	2008	2009	2010	2011
Ksh/USD	76	72	67	69	77	79	89

Source: WB, 2011

### Adjusted

The observed (free market) exchange rate is believed to measure the equilibrium exchange rate. Therefore, no adjustment was necessary.

## DOMESTIC PRICES

For years 2006-2011, average annual wholesale prices in Nairobi were used. These prices were obtained from Kenya's Ministry of Agriculture, Agribusiness Department. For 2005, the national average wholesale price from CountrySTAT was used due to insufficient data on wholesale prices in Nairobi that year. These prices are shown in Table 4 below.

**Table 4: Observed Domestic Wholesale Prices, 2005-2011**

Unit	2005*	2006	2007	2008	2009	2010	2011
Ksh/Tonne	17,802	22,356	19,044	27,044	31,378	32,289	33,333

\*This is the average national wholesale price from CountrySTAT.

Source: MoA-Agribusiness Department, 2011

Due to a lack of reliable producer prices for sorghum, average annual wholesale prices in primary markets within five major production zones of western Kenya – Busia, Kisumu, Nakuru, Eldoret and Kakamega – were taken as the farm gate prices for years 2006-2011. These prices were obtained from Kenya's Ministry of Agriculture, Agribusiness Department. Since data was not available for 2005, the farm gate price in this year was estimated using the average ratio of wholesale to farm gate prices for the period 2006-2011. These prices are shown in Table 5 below.

**Table 5: Observed Domestic Farm Gate Prices, 2005-2011**

Unit	2005*	2006	2007	2008	2009	2010	2011
Ksh/Tonne	15,025	14,717	15,911	23,756	31,302	26,298	32,542

\*Estimated using the average ratio of wholesale to farm gate prices for the period 2006-2011.

Source: MoA-Agribusiness Department, 2011

## ACCESS COSTS

### Observed

Observed access costs reflect the actual cost of bringing domestic or imported sorghum to the wholesale market (i.e. the point of competition). These costs include all marketing costs and margins, whether they are paid-for services, bribes or taxes. Due to a lack of data, access costs for maize reported by the World Bank (2009) were used as a proxy in this analysis. No adjustments to these costs were necessary, since maize and sorghum are similar in density and volume.

It was assumed that maize access costs reported by the World Bank (2009) were based on data collected in 2008, the year before the study was published. Since these costs were only available for a single year, Kenya's Consumer Price Index (CPI) obtained from the Kenya National Bureau of Statistics (KNBS) was used to extrapolate them for each year analyzed, with 2008 as the base year. Table 6 shows the itemized and total observed access costs from the farm gate in western Kenya to the wholesale market in Nairobi, which include all estimated access costs from the primary market to the secondary market and from the secondary market to the wholesale market. Reported transportation costs for each segment of the value chain are assumed to include the trader's margin, though the exact amount or share of this margin relative to the trader's total costs are unknown.

Additionally, Table 6 shows the itemized and total observed access costs from the border in Busia to the wholesale market in Nairobi. These costs include all border crossing costs (specific to Kenya's side of the border only) and long haul transport costs, which were calculated by multiplying the estimated distance between Busia and Nairobi (470 km) by the average unit transport costs for maize (0.11 Ksh/tonne/km) obtained from the World Bank (2009). These transport costs are inclusive of non-tariff barriers, such as bribes and delays at roadblocks and weighbridges.



**Table 6: Observed Access Costs, 2005-2011 (Ksh/tonne)**

	2005	2006	2007	2008	2009	2010	2011
Consumer Price Index (CPI)	0.79	0.83	0.87	1.00*	1.11	1.15	1.31
<i>Primary to Secondary Market (67 Km)</i>							
Storage/rental fee	136	144	150	173	191	199	227
Transportation charges	911	966	1,007	1,159	1,282	1,334	1,521
Hired labor loading/unloading	310	329	343	394	436	454	517
Council cess	73	78	81	93	103	107	123
Roadblocks and weighbridges	182	193	201	231	255	266	303
Drying tent/empty bags	82	86	90	104	115	119	136
Sub-total	1,693	1,795	1,872	2,155	2,382	2,479	2,827
<i>Secondary to Wholesale Market (300 km)</i>							
Storage/rental fee	152	161	168	194	214	223	254
Transportation charges	1,633	1,731	1,805	2,078	2,297	2,391	2,726
Hired labor loading/unloading	341	361	377	434	479	499	569
Council cess	155	164	171	197	218	227	259
Roadblocks and weighbridges	161	171	178	205	226	236	269
Sub-total	2,442	2,589	2,700	3,108	3,435	3,575	4,077
<b>TOTAL (farm gate to wholesale)</b>	<b>4,135</b>	<b>4,384</b>	<b>4,572</b>	<b>5,263</b>	<b>5,817</b>	<b>6,055</b>	<b>6,903</b>
<i>Busia Border Crossing Costs (Kenya Side Only)</i>							
PATA clearing agent fee	66	70	73	84	93	97	111
Kenya Plant Health Inspectorate Services (KEPHIS)	24	26	27	31	34	36	41
Kenya Bureau of Standards (KEBS)	24	26	27	31	34	36	41
Health Certificate	24	26	27	31	34	36	41
Bribe	14	15	16	18	20	21	24
Road use fee	49	52	54	62	69	72	82
Sub-total	203	215	224	258	285	297	339
<i>Busia to Nairobi (470 km)</i>							
Long haul transport costs	2,810	2,980	3,107	3,577	3,953	4,115	4,692
<b>TOTAL (border to wholesale)</b>	<b>3,013</b>	<b>3,195</b>	<b>3,331</b>	<b>3,835</b>	<b>4,239</b>	<b>4,412</b>	<b>5,030</b>

\*Base year used to extrapolate costs for all other years.

Source: WB, 2009, KNBS, 2011

## Adjusted

Adjusted access costs reflect the cost of bringing domestic or imported sorghum to the wholesale market (i.e. the point of competition) in an efficient, well-functioning market. Thus, all government taxes, fees (excluding fees for services), bribes and other non-tariff measures are omitted and “excessive” costs are adjusted. Additionally, “excessive” profit margins exceeding 10 percent of the full financial costs (crop purchase plus access costs) borne by each marketing agent along the value chain are removed.

Adjusted access costs in this analysis were calculated the same way as the observed access costs; however, Council Cess, bribes and delays at roadblocks and weighbridges were removed from the estimates. Table 7 shows the itemized and total adjusted access costs from the farm gate to wholesale and from the border to wholesale in all years analyzed.

**Table 7: Adjusted Access Costs, 2005-2011 (Ksh/tonne)**

	2005	2006	2007	2008	2009	2010	2011
Consumer Price Index (CPI)	0.79	0.83	0.87	1.00*	1.11	1.15	1.31
<i>Primary to Secondary Market (67 Km)</i>							
Storage/rental fee	136	144	150	173	191	199	227
Transportation charges	911	966	1,007	1,159	1,282	1,334	1,521
Hired labor loading/unloading	310	329	343	394	436	454	517
Council cess	0	0	0	0	0	0	0
Roadblocks and weighbridges	0	0	0	0	0	0	0
Drying tent/empty bags	82	86	90	104	115	119	136
Sub-total	1,438	1,525	1,590	1,831	2,023	2,106	2,401
<i>Secondary to Wholesale Market (300 km)</i>							
Storage/rental fee	152	161	168	194	214	223	254
Transportation charges	1,633	1,731	1,805	2,078	2,297	2,391	2,726
Hired labor loading/unloading	341	361	377	434	479	499	569
Council cess	0	0	0	0	0	0	0
Roadblocks and weighbridges	0	0	0	0	0	0	0
Sub-total	2,126	2,254	2,351	2,706	2,991	3,113	3,549
<b>TOTAL (farm gate to wholesale)</b>	<b>3,564</b>	<b>3,779</b>	<b>3,941</b>	<b>4,536</b>	<b>5,014</b>	<b>5,219</b>	<b>5,951</b>
<i>Busia Border Crossing Costs (Kenya Side Only)</i>							
PATA clearing agent fee	66	70	73	84	93	97	111
Kenya Plant Health Inspectorate Services (KEPHIS)	24	26	27	31	34	36	41
Kenya Bureau of Standards (KEBS)	24	26	27	31	34	36	41
Health Certificate	24	26	27	31	34	36	41
Bribe	0	0	0	0	0	0	0
Road use fee	49	52	54	62	69	72	82
Sub-total	189	200	209	240	265	276	315
<i>Busia to Nairobi (470 km)</i>							
Long haul transport costs	2,558	2,713	2,829	3,256	3,599	3,746	4,271
<b>TOTAL (border to wholesale)</b>	<b>2,747</b>	<b>2,913</b>	<b>3,037</b>	<b>3,496</b>	<b>3,864</b>	<b>4,022</b>	<b>4,586</b>

\*Base year used to extrapolate costs for all other years.

Source: WB, 2009, KNBS, 2011

## EXTERNALITIES

No externalities were accounted for in this analysis.

## BUDGET AND OTHER TRANSFERS

Although the government bulks and distributes higher quality sorghum seeds to farmers under the Traditional High Value Crops (THVC) program, no specific data on annual expenditures targeted towards sorghum production are currently available.

## QUALITY AND QUANTITY ADJUSTMENTS

There are no differences between domestic and international prices for sorghum due to quality or quantity factors and, therefore, no adjustments were made in this analysis.

## DATA OVERVIEW

Following the discussion above, a summary of the main data sources and methodological decisions taken for this analysis of price incentives and disincentives is provided below.

**Table 8: Sources of Data Used in the Calculation of Indicators**

Concept	Description	
	Observed	Adjusted
Benchmark price	1. Since Kenya was considered a net importer of sorghum in all years, a unit value CIF price was taken as the benchmark price. Prices for 2005-2010 were obtained from UN Comtrade, while the price for 2005 was obtained from Global Trade Atlas.	N.A.
Domestic price at wholesale	2. Average annual wholesale prices in Nairobi were used for years 2006-2011. These prices were obtained from Kenya's Ministry of Agriculture, Agribusiness Department. For 2005, the national average wholesale price from CountrySTAT was used.	N.A.
Domestic price at farm gate	3. Average annual wholesale prices in five primary markets within the western region of Kenya were used for years 2006-2011. These prices were obtained from Kenya's Ministry of Agriculture, Agribusiness Department. For 2005, the farm gate price was estimated using the average ratio of wholesale to farm gate prices for the period 2006-2011.	N.A.
Exchange rate	4. Average nominal exchange rates reported by the World Bank were used.	N.A.
Access costs from wholesale to the border	5. Estimated based on access costs for maize reported by the World Bank (2009), which include Busia border crossing costs (specific to Kenya's side of the border only) and transport costs from Busia to the wholesale market in Nairobi. Kenya's CPI was used to extrapolate these costs for each year analyzed.	6. Adjusted access costs were calculated the same way as observed access costs. However, government taxes, bribes and delays from roadblocks and weighbridges were removed.
Access costs from wholesale to farm gate	7. Estimated based on access costs for maize reported by the World Bank (2009), which include all costs from the primary to the secondary market and from the secondary market to the wholesale market. Kenya's CPI was used to extrapolate these costs for each year analyzed.	8. Adjusted access costs were calculated the same way as observed access costs. However, government taxes, bribes and delays from roadblocks and weighbridges were removed.
QT adjustment	N.A.	N.A.
	N.A.	N.A.
QL adjustment	N.A.	N.A.
	N.A.	N.A.
	Wh-FG	N.A.

The data used for this analysis is summarized below.

**Table 9: Data and Values Used in the Calculation of Indicators**

		Year	2005	2006	2007	2008	2009	2010	2011
		Trade Status	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>
DATA	Unit	Symbol							
Benchmark Price									
Observed	USD/TONNE	$P_{b(ints)}$	260	327	161	270	415	292	377
Adjusted	USD/TONNE	$P_{ba}$							
Exchange Rate									
Observed	KSH/USD	$ER_o$	76	72	67	69	77	79	89
Adjusted	KSH/USD	$ER_a$							
Access costs border - wholesale									
Observed	KSH/TONNE	$AC_{owh}$	3,013	3,195	3,331	3,835	4,239	4,412	5,030
Adjusted	KSH/TONNE	$AC_{awh}$	2,747	2,913	3,037	3,496	3,864	4,022	4,586
Domestic price at wholesale	KSH/TONNE	$P_{dwh}$	17,802	22,356	19,044	27,044	31,378	32,289	33,333
Access costs wholesale - farm gate									
Observed	KSH/TONNE	$AC_{ofg}$	4,135	4,384	4,572	5,263	5,817	6,055	6,903
Adjusted	KSH/TONNE	$AC_{afg}$	3,564	3,779	3,941	4,536	5,014	5,219	5,951
Farm gate price	KSH/TONNE	$P_{dfg}$	15,025	14,717	15,911	23,756	31,302	26,298	32,542
Externalities associated with production	KSH/TONNE	$E$							
Budget and other product related transfers	KSH/TONNE	$BOT$							
Quantity conversion factor (border - point of competition)	Fraction	$QT_{wh}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Quality conversion factor (border - point of competition)	Fraction	$QL_{wh}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Quantity conversion factor (point of competition – farm gate)	Fraction	$QT_{fg}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Quality conversion factor (point of competition – farm gate)	Fraction	$QL_{fg}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00

## CALCULATION OF INDICATORS

The indicators and methodology used in this analysis are described in Box 1. A detailed description of the calculations and data requirements is available on the MAFAP website or by clicking [here](#).

### Box 1: Methodology and MAFAP Indicators

#### Nominal Rate of Protection (NRP)

MAFAP uses four measures of market incentives and disincentives. *First*, there are two observed nominal rates of protection – one at the wholesale and one at the farm gate – which compare domestic market prices to reference prices free from domestic policy interventions.

Reference prices are calculated from a benchmark price, such as an import or export price expressed in local currency, that is brought to the wholesale and farm gate by adjusting for quality, shrinkage and loss, and market access costs.

The *Nominal Rates of Protection - observed (NRP<sub>o</sub>)* – is the price gap between the domestic market price and the reference price divided by the reference price at both the farm gate and wholesale:

$$NRP_{ofg} = \frac{P_b - AC_{ofg}}{RF_{ofg}} ; NRP_{owh} = \frac{P_b - AC_{owh}}{RF_{owh}}$$

The *NRP<sub>ofg</sub>* captures all trade and domestic policies, inefficiencies along the product's value chain and other factors affecting incentives or disincentives for the farmer. The *NRP<sub>owh</sub>* helps identify where incentives and disincentives may be distributed in the commodity market chain.

*Second*, there are two *Nominal Rates of Protection - adjusted (NRP<sub>a</sub>)* – one at the wholesale and one at the farm gate – in which the reference prices are adjusted to eliminate any distortions found in the commodity value chain (e.g. excessive transport costs, taxes/levies or excessive profit margins of marketing agents). The equations to estimate the adjusted rates of protection, however, follow the same general pattern as those used to calculate the observed rates of protection:

$$NRP_{afg} = \frac{P_b - AC_{afg}}{RF_{afg}} ; NRP_{awh} = \frac{P_b - AC_{awh}}{RF_{awh}}$$

#### Nominal Rate of Assistance (NRA)

If public expenditure allocated to any of the commodities analyzed (*PE<sub>csp</sub>*) is added to the price gaps at the farm gate when calculating the ratios, the *Nominal Rate of Assistance (NRA)* is generated. This indicator summarizes the incentives (or disincentives) due to policies, market performance and public expenditure. Mathematically, the nominal rate of assistance is defined by the following equation:

$$NRA = \frac{(P_b - AC_{afg}) + PE_{csp}}{RF_{afg}}$$

#### Market Development Gap (MDG)

Finally, MAFAP methodology estimates the *Market Development Gap (MDG)*, which is the portion of the price gap that can be attributed to “excessive” or inefficient access costs within a given value chain, exchange rate misalignments, imperfect functioning of international markets and externalities.

“Excessive” access costs may result from factors, such as poor infrastructure, high processing costs due to obsolete technology, government taxes and fees (excluding fees for services), high profit margins captured by various marketing agents, illegal bribes and other non-tariff barriers. Therefore, the total MDG at farm gate is comprised of four components – gaps due to “excessive” access costs ( $ACG_{wh}, ACG_{fg}$ ), the exchange rate policy gap ( $ERPG$ ), international markets gap ( $IMG$ ) and externality gap ( $EXG$ ). When added together, these components are equivalent to the difference between the observed and adjusted price gaps at farm gate.

Similar to the price gaps calculated, the MDG is an absolute measure, which is also expressed as a ratio to allow for comparison across commodities and countries. Consequently, a relative indicator of the total MDG affecting farmers is derived by calculating the ratio between the total MDG at farm gate and the adjusted reference price at farm gate as follows:

$$MDG_{fg} = \frac{(ACG_{wh} + ACG_{fg} + ERPG + IMG + EXG)}{RP_{afg}}$$

In this analysis, only NRPs and MDGs were calculated. The NRA includes budgetary and other transfers to producers. In the case of sorghum in Kenya, calculations of transfers that can be assigned to sorghum production will be calculated and incorporated in a revised version of this technical note. When transfers have been included, the NRA will also be calculated.

**Table 10: MAFAP Price Gaps for Sorghum in Kenya, 2005-2011 (Ksh/tonne)**

	2005	2006	2007	2008	2009	2010	2011
Trade status	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>
Observed price gap at wholesale	(4,877)	(4,417)	4,898	4,536	(4,930)	4,756	(5,196)
Adjusted price gap at wholesale	(4,611)	(4,135)	5,193	4,874	(4,556)	5,145	4,752)
Observed price gap at farm gate	(3,519)	(7,672)	6,337	6,509	811	4,819	916
Adjusted price gap at farm gate	(3,824)	(7,994)	6,000	6,122	383	4,373	408

Source: MAFAP

**Table 11: MAFAP Nominal Rates of Protection (NRPs) for Sorghum in Kenya, 2005-2011 (%)**

	2005	2006	2007	2008	2009	2010	2011
Trade status	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>m</i>
Observed NRP at wholesale	-22%	-16%	35%	20%	-14%	17%	-13%
Adjusted NRP at wholesale	-21%	-16%	37%	22%	-13%	19%	-12%
Observed NRP at farm gate	-19%	-34%	66%	38%	3%	22%	3%
Adjusted NRP at farm gate	-20%	-35%	61%	35%	1%	20%	1%

Source: MAFAP

**Table 12: MAFAP Market Development Gaps (MDGs) for Sorghum in Kenya, 2005-2011 (Ksh/tonne)**

	2005	2006	2007	2008	2009	2010	2011
International markets gap	-	-	-	-	-	-	-
Exchange rate policy gap	-	-	-	-	-	-	-
Access cost gap to wholesale	266	282	294	339	374	390	444
Access cost gap to farm gate	(571)	(605)	(631)	(726)	(803)	(836)	(953)
Externality gap	-	-	-	-	-	-	-
Market development gap	(305)	(323)	(337)	(388)	(428)	(446)	(508)
Market development gap ratio	-2%	-1%	-3%	-2%	-1%	-2%	-2%

Source: MAFAP

## 4. INTERPRETATION OF THE INDICATORS

Figures 7-9 show the results for the set of MAFAP indicators generated, which include price gaps, Nominal Rates of Protection (NRPs) and Market Development Gaps (MDGs). Price gaps are market price differentials between the commodity's domestic and reference price in each respective year. More conceptually, they provide an absolute measure of price incentives or disincentives that sorghum producers face, while NRPs express this absolute measure as ratios that are comparable across countries and commodities. MDGs measure distortions in the value chain, such as excessive access costs, which affect price incentives for producers and wholesalers.

At the wholesale level, observed and adjusted NRPs averaged about 3% and 5%, respectively. As shown in Figure 7 and Figure 8, NRPs and price gaps at wholesale were negative in years 2005, 2006, 2009 and 2011, when Kenya imported sorghum from Europe and/or the United States and were positive in years 2007, 2008 and 2010, when Kenya imported sorghum from the region (see Figure 5). This is partly because benchmark prices were higher in years when sorghum was imported from world markets rather than regional markets. Wholesalers received the highest rates of protection in 2007 and 2008, possibly due to post-election instability, which reduced domestic supplies and presumably raised wholesale prices.

At the farm gate level, observed and adjusted NRPs averaged about 13% and 10% throughout the period analyzed, respectively. As shown in Figure 7 and Figure 8, NRPs and price gaps at the farm gate followed a trend similar to those at the wholesale. In 2009 and 2011, however, the price gaps and NRPs at farm gate were higher than the price gaps and NRPs at wholesale and were close to zero percent, indicating that producers received neither price incentives, nor disincentives.

Given the unusual price and trade patterns that occurred between 2009 and 2011 as a result of the regional drought and food shortage, the price gaps and NRPs in these years are considered special cases that do not necessarily reflect typical market conditions or realities confronted by sorghum farmers. In fact, trade trends indicate that a large share of the imports in 2009 may have actually been food aid shipments sent to Kenya for redistribution to neighboring countries in crisis.

Even if most of the imports were re-exported, some of the food aid may have remained in the country and could have even been subsidized for consumers. If this was in fact the case, it may explain why the farm gate price was nearly equivalent to the reference price, while the wholesale price was low relative to the reference price. The same pattern occurred in 2011, when Kenya imported sorghum from the United States and the region. Again, the imports in 2011 could have been subsidized food aid for consumers, which would help explain the price trends and NRPs that year.

Adjusted NRPs capture the effect of market inefficiencies along the value chain. As shown in Figure 8, adjusted NRPs at wholesale were higher (or less negative) than the observed, whereas adjusted NRPs at the farm gate were lower (or more negative) than the observed. This means that inefficiencies represent opportunity costs for farmers, but not for wholesalers. As shown in Figure 9, market inefficiencies between the border and wholesale actually represent marginal gains for wholesalers because they raise the cost of bringing maize imports from their point of entry to the wholesale market and, therefore, act as natural protection (positive MDGs). However, these gains are



outweighed by inefficiencies between the farm gate and wholesale, which represent costs to farmers (negative MDGs), resulting in a negative net MDG at farm gate in all years.

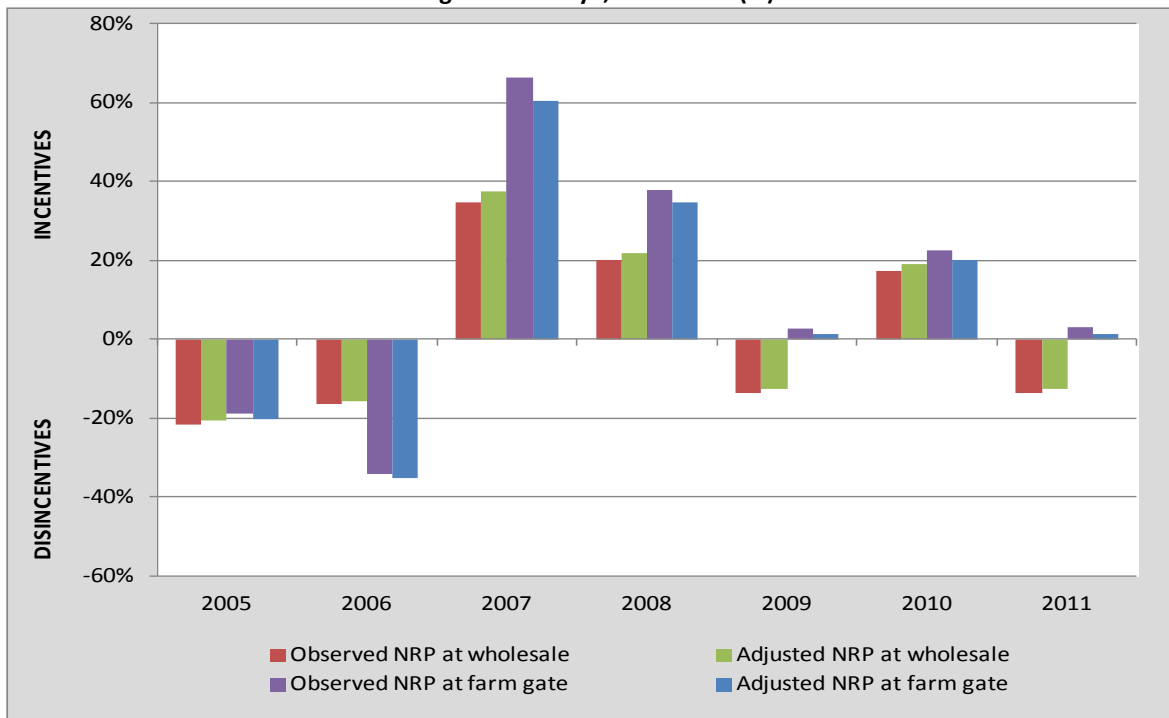
On average, the net MDG amounted to about 2% of the adjusted reference price at farm gate, which is the price that farmers should receive in an efficient market (i.e. in the absence of distortions caused by government policy measures and market functioning). Inefficiencies along the value chain were entirely due to excessive access costs, such as government taxes, illegal bribes and delays at roadblocks and weighbridges. If these distortions were eliminated and the market functioned more efficiently, farmers would be slightly better off than under existing market conditions.

**Figure 7: Observed and Adjusted Price Gaps at Wholesale and Farm Gate for Sorghum in Kenya, 2005-2011 (Ksh/tonne)**



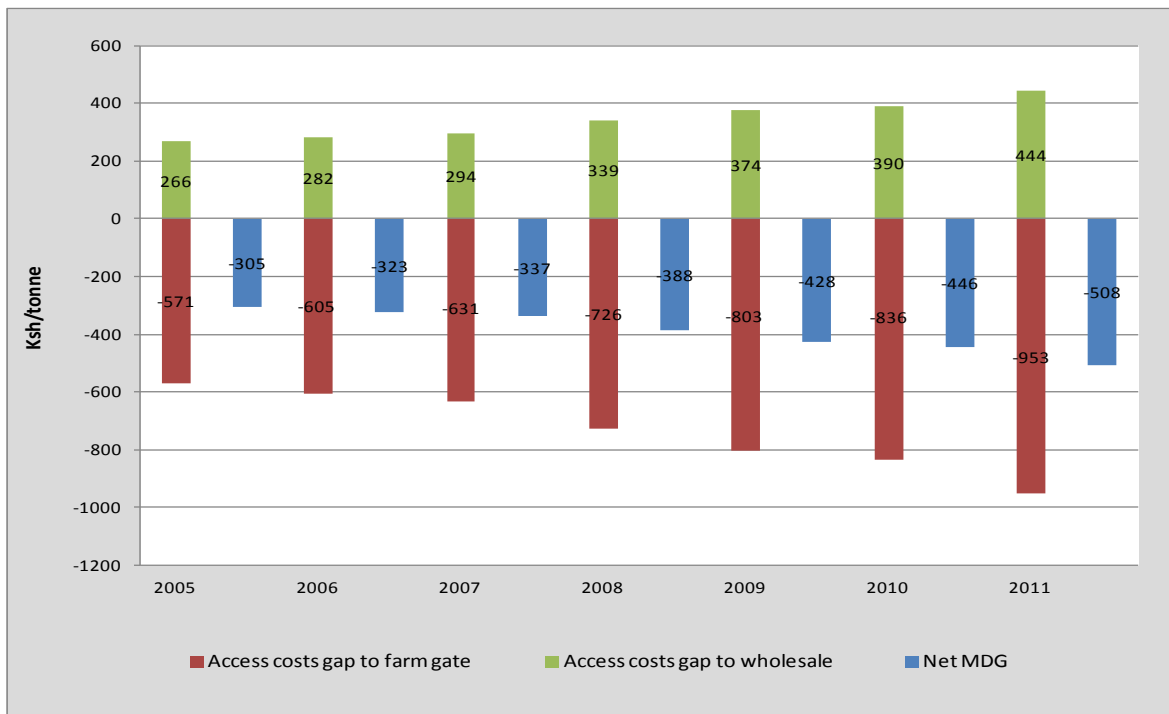
Source: MAFAP

**Figure 8: Observed and Adjusted Nominal Rates of Protection (NRPs) at Wholesale and Farm Gate for Sorghum in Kenya, 2005-2011 (%)**



Source: MAFAP

**Figure 9: Market Development Gaps (MDGs) for Sorghum in Kenya, 2005-2011 (Ksh/tonne)**



Source: MAFAP

## 5. PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

### MAIN MESSAGE

Although a 25% tariff is applied to sorghum imports from outside EAC and COMESA member countries, the results suggest that this has had little effect on domestic prices, since the average NRP at farm gate was -12% for years (2005, 2006, 2009 and 2011) when sorghum was imported from Europe and the United States. One potential explanation for these price disincentives, particularly in 2005 and 2006, is that the tariff on sorghum imports may have been waived due to food shortages during periods of severe drought.

Since there are no tariffs levied on sorghum imports from EAC countries, an NRP around zero percent was expected in years (2007, 2008 and 2010) when Kenya mainly imported sorghum from Uganda and Tanzania. However, the results indicate that the NRP at farm gate averaged about 42% throughout the period analyzed. These strong market price incentives were largely due to high domestic prices relative to regional import prices, which may have resulted from a decline in domestic sorghum production during post-election instability in 2007/2008, as well as a regional drought and food crisis in 2009/2010.

Overall, the results indicate that NRPs varied considerably throughout the period analyzed. The data suggests that most of this variability was due to production shortages, shifts in trade patterns and possibly even food aid subsidies and the removal of import tariffs in certain years. Thus, the volatility of government intervention may create uncertainty in the sorghum market, which not only hinders domestic trade, but also increases the risk borne by farmers. Furthermore, market inefficiencies, such as taxes, bribes and other non-tariff barriers represent opportunity costs for farmers, which reduce price incentives at the farm gate.

Traditionally, sorghum is an inexpensive staple food crop that offers low returns for producers. For this reason, sorghum in Kenya is generally considered a non-tradable or is primarily traded locally. However, domestic sorghum consumption has steadily increased and new marketing channels have opened up in recent years that could potentially offer higher returns for farmers. These channels include the brewing industry, which is contracting farmers to grow higher quality gadam sorghum for alcohol production. Additionally, consumer demand for sorghum flour has risen, especially in urban areas. While domestic sorghum production has increased in response to this growing demand, it continues to fall short, resulting in the need for imports to fill the gap. Without attractive incentives for sorghum farmers, production may continue to fall short of demand and farmers may not be willing or able to take advantage of these new marketing outlets.

### PRELIMINARY RECOMMENDATIONS

Sorghum plays a critical role in increasing food security and income generation in Kenya's ASAL regions because of its resistance to drought conditions, promising commercial uses and low cost relative to other staple foods. According to Miano et al. (n.d.), approximately 10 million Kenyans, with slightly more than half of them in the ASALs, required food relief in 2009 alone. Although higher domestic prices would incentivize sorghum production and increase food supply in these regions, it would also raise consumer prices for sorghum, thereby threatening food security.

Thus, government policies dealing with staple food crops need to strike a difficult balance between providing incentives to producers, while also protecting consumers. However, this is particularly difficult for crops such as sorghum, where consumers are often the same people as producers.

Given these policy constraints, the Government of Kenya (GOK) could focus on reducing costs borne by producers and traders to incentivize production and promote trade. This could be done by increasing the amount of improved seeds provided to sorghum producers in ASAL areas under the Traditional High Value Crops (THVC) program or by developing and enhancing other programs that provide not only improved seeds, but also fertilizers, agrochemicals and other inputs. Additionally, the government could reduce non-tariff barriers to trade such as roadblocks, high council cess, bribes during transport and other fees. The GOK could also help traders gain access to credit and market information as well as improve the marketing infrastructure, such as storage facilities, sale areas and loading/unloading facilities, at major wholesale markets for staple food crops.

## LIMITATIONS

A major limitation in this analysis was the lack of data available on sorghum food aid shipments to Kenya during the period analyzed, as well as data on government subsidies for sorghum imports and domestic sorghum production. Another limitation was the lack of information about the quality of sorghum imports relative to the quality of domestic sorghum.

Given these data constraints, we assumed that there are no significant quality differences between imported and domestic sorghum and that there were no government budget transfers to sorghum producers. We also took the CIF prices reported by Global Trade Atlas and UN Comtrade as the benchmark prices without adjusting for potential food relief sent to Kenya for re-export in certain years.

## FURTHER INVESTIGATION AND RESEARCH

- Collect detailed information on the amount and type of food relief sent to Kenya during the period analyzed in order to better interpret the results and possibly adjust the benchmark prices accordingly;
- Gather more information on government subsidies affecting sorghum procurement and production to improve the analysis;
- Gather more information on the quality of imported sorghum relative to the quality of domestic sorghum to improve the accuracy of the results.

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## **ANNEX I: Methodology used**

A guide to the methodology used by MAFAP can be downloaded from the MAFAP website or by clicking [here](#).

## ANNEX II: Data and calculations used in the analysis

Name of product	Sorghum
International currency	USD

Local currency	Ksh
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DATA	Unit	Symbol	Year trade status	2005	2006	2007	2008	2009	2010	2011	Notes	
				m	m	m	m	m	m	m		
<b>Benchmark Price</b>												
1	Observed	USD/Tonne	$P_{D(USD)}$	260.31	327.02	160.65	269.94	414.60	291.83	377.20		
1b	Adjusted	USD/Tonne	$P_{DB}$									
<b>Exchange Rate</b>												
2	Observed	Ksh/USD	$ER_C$	75.55	72.10	67.32	69.18	77.35	79.23	88.81		
2b	Adjusted	Ksh/USD	$ER_A$									
<b>Access costs border - wholesale</b>												
3	Observed	Ksh/Tonne	$ACo_{wh}$	3,013.00	3,194.85	3,331.44	3,834.65	4,238.62	4,411.75	5,030.38		
3b	Adjusted	Ksh/Tonne	$ACa_{wh}$	2,746.79	2,912.58	3,037.10	3,495.85	3,864.13	4,021.97	4,585.94		
4	Domestic price at wholesale		Ksh/Tonne	$P_{Dwh}$	17,802.00	22,355.56	19,044.44	27,044.44	31,377.78	32,288.89	33,333.33	
<b>Access costs wholesale - farm gate</b>												
5	Observed	Ksh/Tonne	$ACo_{fg}$	4,594.24	4,871.52	5,079.81	5,847.09	6,463.08	6,727.07	7,670.35		
5b	Adjusted	Ksh/Tonne	$ACa_{fg}$	3,802.80	4,032.32	4,204.72	4,839.83	5,349.70	5,568.22	6,349.01		
6	Farm gate price		Ksh/Tonne	$P_{Dfg}$	15,024.94	14,716.67	15,911.11	23,755.56	31,302.22	26,297.78	32,542.22	
7	Externalities associated with production		Ksh/Tonne	E								
8	Budget and other product related transfers		Ksh/Tonne	BOT								
	Quantity conversion factor (border - wholesale)		Fraction	$QT_{wh}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	Quality conversion factor (border - wholesale)		Fraction	$QL_{wh}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	Quantity conversion factor (wholesale - farm gate)		Fraction	$QT_{fg}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	Quality conversion factor (wholesale - farm gate)		Fraction	$QL_{fg}$	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

CALCULATED PRICES				2005	2006	2007	2008	2009	2010	2011	Formula
<b>Benchmark price in local currency</b>											
9	Observed	Ksh/Tonne	$P_{D(LOCB)}$	19,666.25	23,577.82	10,814.80	18,674.12	32,069.37	23,121.62	33,499.13	[1]*[2]
10	Adjusted	Ksh/Tonne	$P_{D(LOCBA)}$	19,666.25	23,577.82	10,814.80	18,674.12	32,069.37	23,121.62	33,499.13	[1]*[2]
<b>Reference Price at wholesale</b>											
11	Observed	Ksh/Tonne	$RPo_{wh}$	22,679.24	26,772.67	14,146.24	22,508.76	36,307.99	27,533.38	38,529.51	([9]*[QTwh])*[QLwh]+[3]
12	Adjusted	Ksh/Tonne	$RPa_{wh}$	22,413.04	26,490.40	13,851.90	22,169.97	35,933.50	27,143.59	38,085.07	([10]*[QTwh])*[QLwh]+[3b]
<b>Reference Price at Farm Gate</b>											
13	Observed	Ksh/Tonne	$RPo_{fg}$	18,085.01	21,901.15	9,066.44	16,661.67	29,844.92	20,806.31	30,859.16	(((11)*[QLfg])*[QTfg])-[5]
14	Adjusted	Ksh/Tonne	$RPa_{fg}$	18,610.24	22,458.08	9,647.18	17,330.13	30,583.80	21,575.37	31,736.06	(((12)*[QLfg])*[QTfg])-[5b]



INDICATORS		Unit	Symbol	2005	2006	2007	2008	2009	2010	2011	Formula
<b>Price gap at wholesale</b>											
15	Observed	Ksh/Tonne	PG <sub>0wh</sub>	(4,877.24)	(4,417.11)	4,898.20	4,535.68	(4,930.21)	4,755.51	(5,196.18)	[4]-[11]
16	Adjusted	Ksh/Tonne	PG <sub>awh</sub>	(4,611.04)	(4,134.84)	5,192.54	4,874.48	(4,555.73)	5,145.30	(4,751.74)	[4]-[12]
<b>Price gap at farm gate</b>											
17	Observed	Ksh/Tonne	PG <sub>0fg</sub>	(3,060.07)	(7,184.48)	6,844.68	7,093.89	1,457.31	5,491.47	1,683.06	[6]-[13]
18	Adjusted	Ksh/Tonne	PG <sub>afg</sub>	(3,585.30)	(7,741.41)	6,263.93	6,425.42	718.42	4,722.40	806.16	[6]-[14]
<b>Nominal rate of protection at wholesale</b>											
19	Observed	%	NRPO <sub>wh</sub>	-21.51%	-16.50%	34.63%	20.15%	-13.58%	17.27%	-13.49%	[15]/[11]
20	Adjusted	%	NRPA <sub>wh</sub>	-20.57%	-15.61%	37.49%	21.99%	-12.68%	18.96%	-12.48%	[16]/[12]
<b>Nominal rate of protection at farm gate</b>											
21	Observed	%	NRPO <sub>fg</sub>	-16.92%	-32.80%	75.49%	42.58%	4.88%	26.39%	5.45%	[17]/[13]
22	Adjusted	%	NRPA <sub>fg</sub>	-19.27%	-34.47%	64.93%	37.08%	2.35%	21.89%	2.54%	[18]/[14]
<b>Nominal rate of assistance</b>											
23	Observed	%	NRA <sub>o</sub>	-16.92%	-32.80%	75.49%	42.58%	4.88%	26.39%	5.45%	[(17)+[8]]/[13]
24	Adjusted	%	NRA <sub>a</sub>	-19.27%	-34.47%	64.93%	37.08%	2.35%	21.89%	2.54%	[(18)+[8]]/[14]

Decomposition of PWAfg			Unit	Symbol	2005	2006	2007	2008	2009	2010	2011	Formula
25	International markets gap	Ksh/Tonne	IRG	-	-	-	-	-	-	-	-	
26	Exchange policy gap	Ksh/Tonne	ERPG	-	-	-	-	-	-	-	-	
27	Access costs gap to wholesale	Ksh/Tonne	ACG <sub>wh</sub>	266.20	282.27	294.34	338.80	374.49	389.79	444.44		[(3)-[3b]]*QLfg*QTfg
28	Access costs gap to farm gate	Ksh/Tonne	ACG <sub>fg</sub>	(791.43)	(839.20)	(875.08)	(1,007.26)	(1,113.37)	(1,158.85)	(1,321.35)		[5b]-[5]
29	Externality gap	Ksh/Tonne	EG	-	-	-	-	-	-	-	-	
	Market Development Gap	Ksh/Tonne	MDG	(525.23)	(556.93)	(580.74)	(668.46)	(738.88)	(769.07)	(876.91)		[25]+[26]+[27]+[28]+[29]
	Market Development Gap	%	MDG	-2.82%	-2.48%	-6.02%	-3.86%	-2.42%	-3.56%	-2.76%		MDG/RPa fg



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