Socioeconomics
Discussion Paper Series

Series Paper Number 16

The value chain for sorghum beer in Kenya

A. Orr, C. Mwema, W. Mulinge[1]
ICRISAT, Nairobi, A.Orr@cgiar.org

[1]: KARI, Nairobi, Kenya

4/16/2013

ICRISAT
Science with a human face

International Crops Research Institute
for the Semi-Arid Tropics

Disclaimer

This paper is part of ICRISAT Economics Discussion paper series. This series disseminates the findings of work in progress to encourage the exchange of ideas about a wide array of issues in the area of agriculture for development. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. Any comments and suggestions are more than welcome and should be addressed to the author who's contact details can be found at the bottom of the cover page. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Crops Research Institute for the Semi-Arid Tropics and its affiliated organizations.

About ICRISAT

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market- Oriented development (IMOD). ICRISAT is headquartered in Patancheru near Hyderabad, Andhra Pradesh, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. www.icrisat.org

CGIAR is a global agriculture research partnership for a food secure future. Its science is carried out by 15 research Centers who are members of the CGIAR Consortium in collaboration with hundreds of partner organizations. www.cgiar.org

This work has been undertaken as part of the CGIAR RESEARCH PROGRAM ON Policies, Institutions and Markets

Acknowledgements: We would like to acknowledge all the persons and organizations who contributed to this research. For information, special thanks go to Sylvester Ndeda, David Kinuthia, Bernard Oyoo and David Kinuthia of East African Breweries Ltd (EABL), Paul Muthangya (EUCORD), Silas Mwiti Ragwa (KARI Seed Unit), Taylor Mburu (Africa Harvest), Consolata (Jukoma Enterprises), and Wambui (Sky pub bar).

The Smart Logistics team, Rose Mutuku and Wilson Muchiri Theuri shared information on their business model, and Smart Logistics field officers, Loise Mwangangi, Pauline Kanani, Saili Mulevu and Jeff Mweti assisted with the reconnaissance visits and the grower survey. Rhoda Mulevu (Chairperson, Maliku cluster), Linah Nzambi (Chairperson, Kawongo cluster), and William Komo (Chairperson, Kanduti Farmers field school cluster) assisted with sampling of group members. We thank Bernard Munyua for assistance in supervision of the grower survey and our 12 enumerators, Chris Musyoki, Mercy Ndakithi, Anna Mwelu, Charles Mulevu, Celestine Mutheu, Dorothy Mutheo, Damaris Mwikali, Kingoo Munyao, Samson Kioko, Ruth Mutua, Nicholas Kiteme and Mutinda Anthony. Finally, thanks to the officials of the Smart Logistics farmer groups and their members who took time to participate in the survey.

Joachim Weber gave advice on ValueLinks methods for value chain mapping and value addition.

Abstract

This discussion paper analyses the value chain for sorghum beer in Kenya, from growing Gadam sorghum to the production and retailing of Senator Keg. The business model developed by Smart Logistics Solutions Ltd. was used to analyze social inclusion in the value chain. A stratified random sample of 300 members and non-members of Smart Logistics groups in eastern Kenya was sampled in the main growing season for sorghum in 2012-2013. Based on interviews with major actors, the Value Links methodology was used to map the value chain and quantify value addition at different stages of the value chain. Analysis of value addition showed that growers received 4 % of the retail price of sorghum beer, Smart Logistics 1 %, EABL 81 %, Senator keg distributors 5 % and Senator keg retailers 9 %. No information was available on intermediate costs or value added for sorghum brewing. Profitability for Smart Logistics depended on volume while, following the imposition of excise duty in 2013, profitability for retailers was negative. The average member of a Smart Logistics group planted 1.71 acres to sorghum and harvested 483 kg per household of which 305 kg (63 %) was sold. Shortage of land, shortage of labour, and low profitability were reported as the most important constraints on sorghum production. Bird-scaring and threshing were the two most important labour constraints. Ninety percent of group members sold their sorghum to Smart Logistics. The main complaint by members was the time spent waiting for payment. The average time waiting for payment was 4.5 weeks. Only 5 % of growers were paid within the 1-week target set by Smart Logistics. On average, members selling to a Smart Logistics collection centre in 2012 sold 342 kg of sorghum at a price of 25 KES/kg, earning KES 8,550 from sorghum sales. Most income from sorghum was invested in children's education. Members of Smart Logistics groups spent an average of KES 32,000 on education per year, of which KES 18,000 went on university education. Income from sorghum (KES 8,550) was equivalent to one quarter of annual investment in

education. A significantly higher share (83%) of the members of Smart Logistics groups reported an improvement in their economic position since 2009 compared to non-members (70%).Members of Smart Logistics groups were significantly more likely to be headed by women, have high dependency ratios, and own less land per adult family member. Membership was not significantly related to income per head. The main reason given by non-members for not joining a Smart Logistics group was that they did not have time to attend group meetings and meetings at demonstration plots. The price of sorghum beer depends on the level of excise duty. From 2004 Senator Keg enjoyed zero excise duty, making it competitive with illegal brews. As a result, Senator Keg became EABL's best-selling beer by volume. However, a sharp rise in public expenditure and domestic debt has increased the need for government to raise tax revenues. Following imposition of a 50 % excise duty in 2013, sales of Senator keg have fallen by an estimated 80 %. In the long-term, the future of sorghum beer in Kenya depends on growth in income per head. In the short term, it depends on lower excise duty to make it more affordable for low-income consumers.

Keywords: Value chain, sorghum beer, value addition, social inclusion

JEL classification: Q110, Q130, L660

Contents

1 Introduction

Sorghum (Sorghum bicolor (L.) Moench) is widely grown as a food crop in Sub-Saharan Africa, but commercialization has proved difficult for several reasons. Sorghum is grown in marginal, semi-arid environments characterized by low and erratic rainfall. In drought years, growers prioritize household food security and are reluctant to sell, making it difficult for buyers to ensure a consistent supply. Semi-arid environments are also characterized by low population density, poor infrastructure, and limited access to markets, which raises transaction costs and reduces incentives for both growers and buyers.

Recently, competition for Africa's growing beer market has stimulated commercialization of sorghum to produce clear sorghum beer. The development of the value chain for sorghum beer has involved partnerships between national governments, multinational companies, plant breeders, intermediary suppliers, and sorghum growers (van Wijk and Kwakkenbos, 2011). Competition between multinational breweries has spurred the rapid spread of this value chain and sorghum beer is currently produced in Nigeria, Ghana, Sierra Leone, Kenya, Uganda, and Zambia. Multinational breweries view the value chain for sorghum beer as a model for 'inclusive business' that can be replicated across Africa (Diageo plc, 2011). Increased demand for local sorghum is expected to benefit smallholders and contribute to poverty reduction. However, there has been no systematic evaluation of the benefits to smallholders from the value chain for sorghum beer in Kenya or whether it is justified to describe this value chain as 'pro poor'.

This study explores the value chain for sorghum beer from production to consumption. The main objective of the study was to assess the benefits of the value chain for smallholders. The specific objectives were to:

1. Map the value chain for sorghum beer in Kenya;
2. Measure value addition by input suppliers, growers, intermediaries, and brewers;
3. Identify the challenges faced by the value chain actors;
4. Identify the factors influencing growers' participation in the value chain; and
5. Assess the inclusiveness of the Smart Logistics business model.

The report is organised as follows. The next section discusses methodology. Section 3 provides the context for the development of sorghum beer in Kenya. The value chain is analysed in Section 4, while section 5 presents the results of the grower survey. Section 6 analyses inclusion in the Smart Logistics business model, while the final section summarises our conclusions.

2 Data and methods

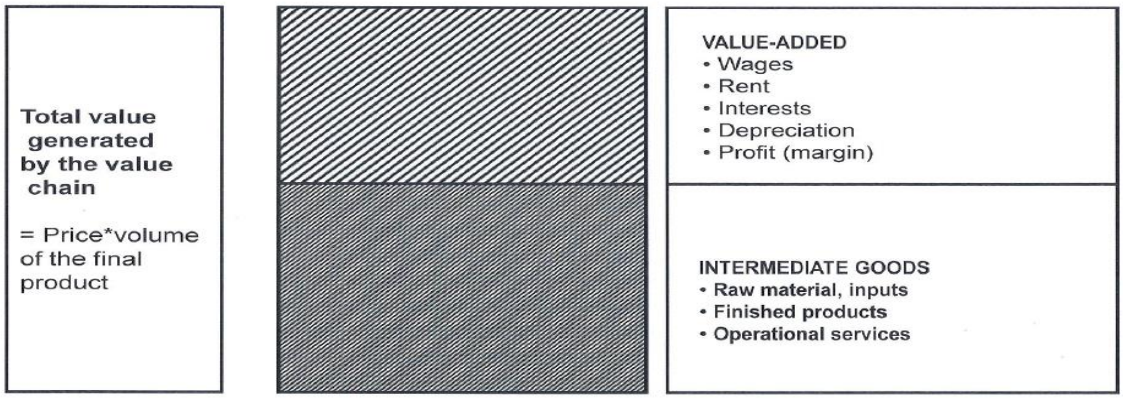
2.1 Value chain mapping

Information on value addition was obtained from interviews held with key informants from Smart Logistics, EABL, EUCORD, Africa Harvest, KARI Katumani Commercial Seed Unit, Senator keg distributors and retailers. The value chain was mapped using the ValueLinks approach (GTZ, 2007).

2.2 Value addition

Value added is defined as the additional value of a commodity over the cost of the commodity used to produce it in the previous stage of production. Costs and revenues for the different actors were collected. Value added for each value chain actor was estimated using the ValueLinks definition, subtracting the costs of intermediate inputs from the total value generated (Figure 1). For primary producers, the customary practice is to ignore intermediate inputs and equate value added with the sales price. Family labour is valued at zero on the assumption that no more profitable opportunity is available. For other actors in the value chain, intermediate costs include the cost of 1 kg of sorghum grain, the cost of other inputs, and the cost of operational services. These include services that are outsourced or services (water, electricity, transport, licences) bought from other service providers. Since EABL did not provide information on costs, we were unable to estimate value addition for brewing. To compare the value added at different stages in the value chain, we standardized value addition per kg of sorghum grain.

Figure 1. Value addition calculations



Source: GIZ (2007) ValueLinks Module 2.

2.3 Growers survey

A multistage stratified sampling technique was used to randomly select 300 sorghum growers (150 members of Smart Logistics groups and 150 non-members). First, we purposely selected three clusters located in Lower Yatta, Katulani, and Nzambani districts where Smart Logistics groups had started operations in 2009. Second, five Smart Logistics groups were randomly sampled from each cluster, giving a total of 15 groups. Third, we

randomly sampled 10 members from each group (Table 1). As a control group, we randomly selected 150 non-members, living in the same villages as members, from a list of sorghum growers provided by village chiefs. Three households were later dropped from the analysis when they proved not to be sorghum growers, giving a final sample size of 297 households.

Table 1: Smart Logistics groups sampled for grower survey, Kitui district, 2012-2013

Cluster	Group	Year established	Members (no.)			Sample (no.)		
			Female	Male	Total	Female	Male	Total
Kanduti Farmers Field School, Nzambani district	Kanduli Savings and Credit	2008	16	8	24	6	4	10
	Wendo Self Help	2008	15	10	25	5	5	10
	Maoseo Tyaa Self Help	2001	18	7	25	6	4	10
	Umisyo Self Help	2008	22	3	25	8	2	10
	Twekanie Self Help	2009	20	5	25	7	3	10
Maliku Cereal Growers Association, Katulani district	Wendo wa Maliku	2003	13	3	16	8	2	10
	Kalimani women's	2006	24	0	24	10	0	10
	Umisyo wa w'o Self Help	2008	22	0	22	10	0	10
	Kalimani Youth	2002	13	3	16	8	2	10
	Maliku Cotton Growers	2000	14	19	33	4	6	10
Kawongo Cereal Growers Association, Lower Yatta district	Kyama Kya mavata	2000	16	3	19	8	2	10
	Wendo wa Ikuuni	1994	12	8	20	5	5	10
	Tiva Self Help	2000	14	7	21	6	4	10
	Kyambusya adult class	2000	27	6	33	8	2	10
	Ushindi Self Help	2005	10	7	17	5	5	10

A survey questionnaire was designed and pretested in all three clusters. The questionnaire covered the 2012 agricultural year, including both the short and long rains (October-December 2012 and March-June 2012, respectively). In Kitui county sorghum is mostly grown in the short rains because rainfall is more reliable. The survey was conducted by 12 Kikamba-speaking enumerators in June 2013, in order to capture income from sorghum sales made in early 2013. Information on partial budgets for Gadam sorghum was obtained from interviews with six purposively selected farmers in Smart Logistics groups (two per cluster) who had received training in sorghum production.

2.4 Social inclusion

Selection criteria for membership of Smart Logistics groups were obtained from interviews with leaders of three Smart Logistics clusters. The grower survey also asked non-members why they had not joined a Smart Logistics group. Finally, regression analysis was used to analyze the socio-economic variables that determined inclusion in Smart Logistics group. Of the 297 sorghum growers in the sample, 150 were members of Smart Logistics groups and of the 147 non-members, 75 were sorghum sellers while 72 were non-sellers. Logistic regression was used to estimate the importance of 10 inclusion indicators for members (150 households) and non-members (147 households). Multinomial logistic regression was also used to estimate the importance of inclusion indicators for members compared to non-member sellers and non-member-sellers.

3. Why sorghum beer?

3.1 Factors influencing emergeance of sorghum beer

3.1 The emergence of sorghum beer in Kenya was the result of a combination of factors, on both the supply and demand sides (Table 2). In this section, we analyze the role that each of these factors played in the development of sorghum beer.

Sorghum beer is relatively new in Kenya. Kenya's first locally-produced sorghum beer – Senator – was released in 2003. Disappointing sales of Senator led to the launch in 2004 of Senator keg. As the name suggests this was an un-bottled sorghum beer targeted at 'aspirational' consumers wanting to 'trade up' from home-brewed drinks but could not afford bottled beers made from more expensive malted barley. Senator keg is marketed as an 'intermediate' product that does not compete with EABL's flagship brands. According to Euro monitor, Senator Keg is the second-most popular beer in Kenya, commanding 15.3 per cent of the beer market by volume in 2011 and has earned EABL $380 million in net sales[1].

[1] Hustlers now mourn tax hike on Senator Keg in the 2013/14 Kenya Budget. *Standard Digital*, 15 June 2013.

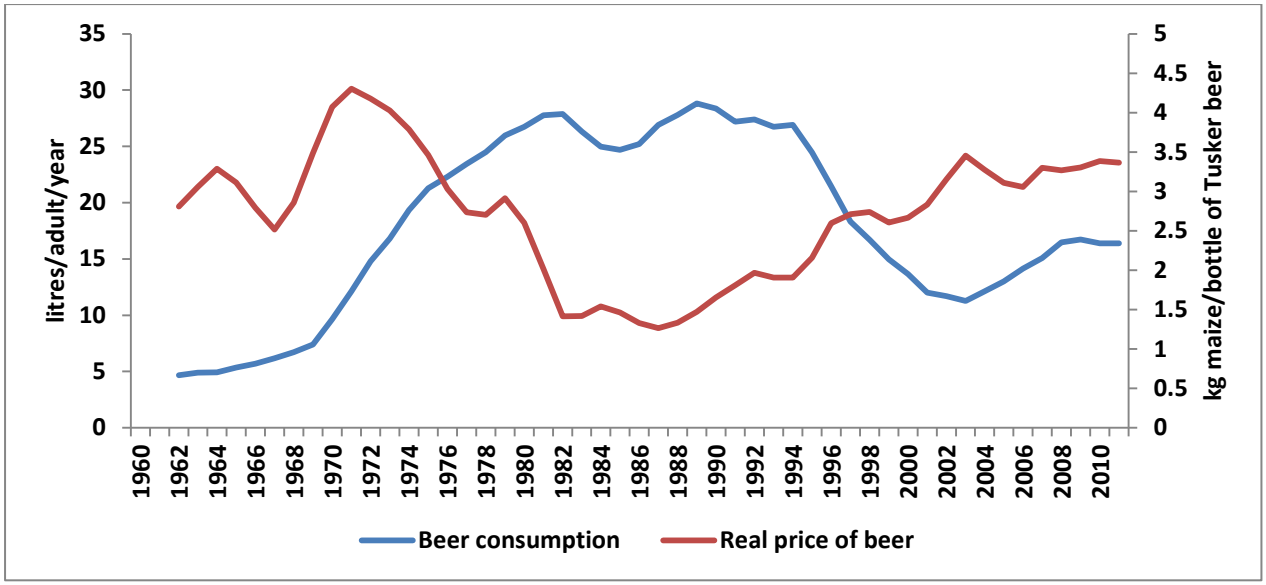
Table 2: Timeline for sorghum beer in Kenya, 1993-2013

1992	General and Presidential elections, December
1993	Government increases combined taxes on beer to 153% per unit
1993-2003	Beer consumption in Kenya falls from 14 to 8 litres *per capita*
1997	EABL launches 'Citizen' Lager, a non-malted, bottled barley beer
1998	SAB Miller enters Kenyan beer market with subsidiary Castle Brewing, Thika
2002	SAB Miller exits Kenyan beer market
2003	EABL launches 'Senator' a non-malted barley beer, for $0.33 per 300 ml bottle
2004	Government reduces excise tax for non-malted keg beer to 30 %
2004	EABL re-launches 'Senator' as 'Senator Keg' for $0.27 per 300 ml glass
2006	Government reduces excise tax for non-malted keg beer by 100 %
2007	General and presidential elections, December
2008	Production of 'Senator Keg' overtakes production of 'Tusker'
2009	EABL buys a majority stake in Serengeti Breweries, Tanzania
2010	Production of 'Senator Keg' reaches 2 million hectolitres
2013	General and presidential elections, March
2013	Government introduces 50 % excise duty on non-malted keg beer
2013	Alcoholic Drinks Control (Amendment) Bill 2010 (the 'Mutotho law') restricts drinking hours and legalizes licensed production of bottled *chang'aa*

3.1.1 Falling consumer demand

Sorghum beer was launched as an attempt to halt falling sales. Beer production in Kenya grew rapidly after independence in 1963, but there was a steep fall in beer production after 1993, from 368 million litres in 1992 to 184 million litres in 2001 (Figure 2). Production did not begin to recover until 2004. Falling production reflected declining demand for beer. One reason for falling demand was rising prices. The real price of bottled beer (deflated by the retail price of maize grain) fell steadily in the 1960s and 1970s. However, prices have increased since the mid-1980s. In 2010, the price of a bottle of beer was equivalent to 3.9 kg of maize, up from just 1.1 kg of maize in 1980. Since 2000, however, average beer consumption has risen despite rising real prices, from 11 litres/adult in 2002 to 18 litres/adult in 2011.

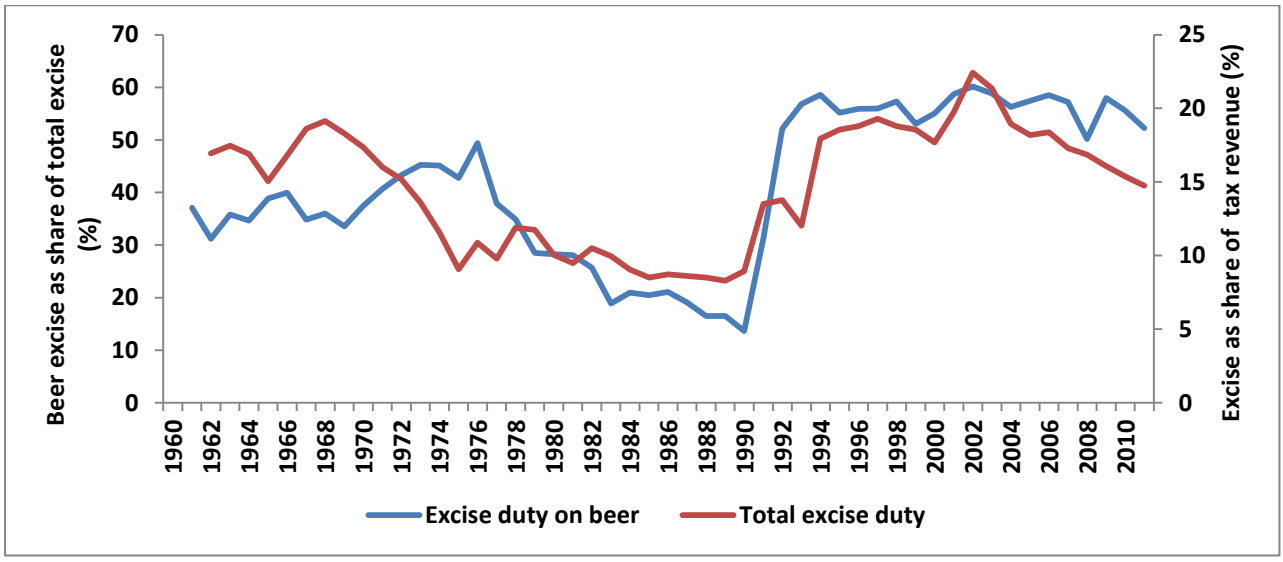
Figure 2: Recorded beer consumption per head and the real price of beer in Kenya, 1963-2011 (3 year moving averages).



Source: Kenya *Statistical Abstracts*, various years.

Rising prices reflected declining consumer income, and also higher excise taxes on beer. Real income per head fell throughout the 1990s, and did not recover until 2003. In 2006, real income per head averaged KES 34,000, the same level as in 1990. This 'lost decade' reduced disposable income and encouraged consumers to search for cheaper sources of alcohol, particularly illicit brews. Higher excise taxes reflected the government's failure to generate tax revenue from other sources. Following President Moi's election victory in 1992, taxation on bottled beer rose to 153 % per unit. (It was no accident that Moi's nearest rival for the Presidency was Kenneth Matiba, a former chairman of EABL, and that EABL had openly supported multi-party elections). As a result, the share of beer in total excise revenue rose sharply, from just 16 % in 1989 to 59 % in 1994, and has remained at between 50-60 % of excise revenue to this day (Figure 3). In consequence, excise taxes also rose as a share of total tax revenue, from contributing about one-tenth of tax revenue in the 1980s to as much as one fifth in the 1990s. Higher excise taxes were passed on directly to consumers who were already struggling to meet higher living costs.

Figure 3: Beer excise, excise revenue and total tax revenue in Kenya, 1962-2011.

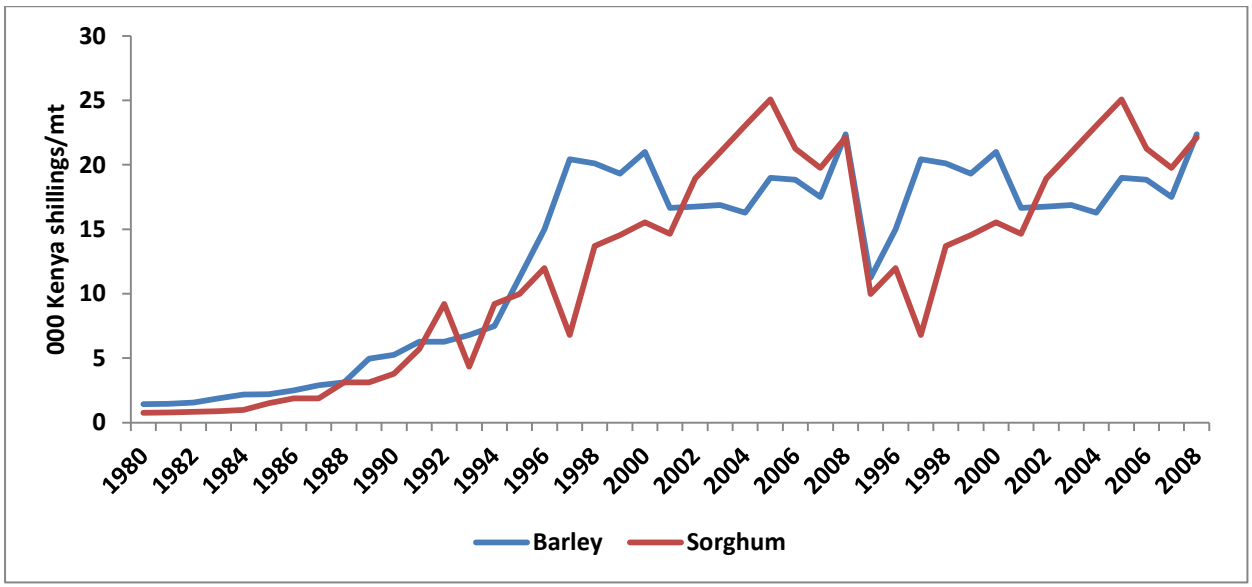


Source: Kenya *Statistical Abstracts*, various years.

3.1.2 Rising production costs

Devaluation of the Kenya shilling in the 1990s raised the cost of imported malt, while the price of barley also rose sharply in the 1990s relative to the price of sorghum (Figure 4). Although barley is produced in Kenya, price fluctuations encouraged EABL to search for cheaper alternatives. In addition, sorghum can be used to produce beer directly without the added cost of malting. According to EABL, replacing barley with sorghum cut production costs by 20-30 %.

Figure 4: Producer prices for sorghum and barley in Kenya, 1980-2008



Source: World Bank, *African Development Indicators*.

3.1.3 Increased competition

After independence in 1963 EABL swiftly bought out smaller breweries and enjoyed a virtual monopoly until 1998, when SAB Miller bought Castle Brewing in Thika. This sparked a 'Beer War' between EABL and SABMiller. Competition between EABL and SABMiller for Kenya's shrinking beer market hurt revenues and intensified the pressure on EABL to make a cheaper beer. The 'Beer war' ended with a truce in 2002 when SABMiller sold Castle Brewing to EABL, which promptly closed it down. In return, EABL closed Kibo Breweries in Moshi, Tanzania, with SABMiller agreeing to distribute EABL beers in Tanzania and EABL agreeing to distribute SABMiller beers in Kenya.

Another source of competition was 'new generation' or 'power drinks (Willis, 2003). These emerged as a direct response to higher prices for bottled beer. Although packaged as 'modern' drinks, they were classed as 'traditional', and attracted an excise tax of just 10%. In terms of alcohol content, 'power drinks' were four to five times cheaper than EABL's 'Citizen' lager and successfully competed for the lower end of the market. Although EABL successfully lobbied for a government ban on 'power drinks' in 1998, this proved impossible to enforce. At the same time, the government lifted the ban on the manufacture of palm wine, a favorite on the coast (Willis, 2009). Clearly, the lack of a consistent or effective policy towards illegal alcohol meant that EABL had to compete on price.

3.1.4 Tax breaks

A key factor in Senator's success was the tax break granted to non-malted beers. Market research by EABL revealed that 56 % of alcohol consumption consisted of traditional fermented brews (*busaa*) or distilled spirits (*chang'aa),* which were illegal and therefore untaxed. Eliminating excise duty would encourage consumers to switch to Senator keg, boost sales of legal beer, and allow government to collect some of the tax lost from the sale of illicit brews. In 2004 the government granted a remission of 30 % on excise duty, increased to 100 % in 2006. This allowed Senator keg to be sold at $0.20 per 300 ml glass, the same price as most illicit brews. The tax break on Senator Keg lasted until 2013, when the government re-imposed an excise duty of 50 %, on the grounds that 'it has been difficult administratively to differentiate between various beer products and Senator keg, thereby posing a threat to revenue collection'[2] Beer made from sorghum, millet and cassava continued to enjoy full remission in excise duty, however.[3] Just as the decision to raise excise duty on beer followed elections in December 1992, so the decision to impose excise duty on sorghum beer followed elections in March 2013. Election expenses and salary increases for public-sector workers made it imperative to increase government revenues.[4] Excise duty on sorghum beer was expected to generate an additional KES 6.2 billion in tax revenue. As a result, the price of Senator keg rose from KES 20 to between KES 45-50 per 300 ml glass. According to EABL, the price increase cut sales of Senator keg by 80 %.[5]

[2] Budget Speech 13th June 2013, paragraph 78. http://www.citizennews.co.ke/news/2012/local/item/11232-budget-2013-2014-speech-by-henry-rotich

[3] 'EABL sees sales drop after new tax measures on Senator Keg'. Business Daily Jan 23 2014.

[4] By 2013 the wage bill for the public sector consumed 54 % of total government revenue. Daily Nation, March 11, 2014.

[5] 'EABL targets Senator market with Sh10 spirit'. *Business Daily*, January 23, 2014.

Falling sales forced EABL to reduce production at its main Nairobi plant in Ruaraka from seven to five days a week.[6]

3.1.5 Health scares

An important factor in the government's decision to remit excise tax for Senator keg was the health risk posed by illicit brews. Higher prices for bottled beer encouraged consumers to search for cheaper alternatives. Cases of poisoning from 'power' drinks or from *chang'aa* captured the headlines.[7] The government was blamed for taxing beer beyond the reach of poorer consumers. The Ministry of Health supported EABL's campaign for tax breaks on non-malted beers, on public health grounds (Ogola and Mungai, 2011b: 6). Conversely, one of the reasons given for re-instating excise tax on Senator keg in 2013 was that it had not reduced consumption of *chang'aa*.

3.1.6 The future for sorghum beer

Sorghum beer in Kenya has been described as a win-win-win story: bigger sales for EABL, cheaper, safer beer for ordinary Kenyans, and more tax revenue for government (EABL, 2013). However, events have not exactly followed this script. True, Senator keg has boosted beer sales in Kenya, and helped EABL recover from the drop in beer production following the hike in excise duty on beer in 1993. Increased sales have also produced more corporate and value added tax for the government, although whether this has compensated for the remission in excise duty is unclear. Finally, consumers have benefitted from cheaper beer. However, although EABL claimed that Senator keg had captured half the market for illicit brews (EABL, 2013), no research has been conducted to evaluate its impact on public health. Although Senator keg was competitively priced with *chang'aa*, the higher alcohol content of illicit brews makes them more attractive to poorer consumers. In a tacit admission that this strategy had failed, in 2010 the government legalized the manufacture and sale of bottled *chang'aa*. Following the decline in sales of Senator keg as the result of higher prices, EABL's new marketing strategy to attract poorer consumers has been to develop a cheaper brand of spirits.[8] Thus, the success of sorghum beer in Kenya rested on fragile foundations that could crumble overnight if government changed its mind over the benefits from reduced taxation.

[6] 'EABL stops daily brewing as growth hits a four-year low', *Business Daily*, March 13, 2014.
[7] Poisoning from *chang'aa* resulted from adulteration with jet fuel, methanol, battery acid, and embalming fluid. Less lethal ingredients reportedly included decomposing rats and women's underpants. 'Kill me quick: Kenya's lethal brew deserves its name'. *The Economist*, April 29th 2010.
[8] 'EABL targets Senator Market with Sh10 spirit'. *Business Daily*, January 23, 2014.

4. The value chain

4.1 Mapping the value chain

The value chain for sorghum beer includes a variety of actors (Figure 5). The first row functions in the value chain (arrows) with operators in the two centre rows (rectangles) and support service providers on bottom row (sim-card rectangles). An 'operator' is as an actor that takes ownership of the product at some stage in the value chain, to distinguish them from service providers. 'Operational service providers' provide services to specific operators (eg. transporters), while 'support service providers' provide services at the meso-level (eg. agricultural research). Vertical arrows show the linkages between actors in the value chain. The position of the service provider in relation to the functions shows which specific operators they support.

4.1.1. KARI Seed Unit

Sorghum beer is made from Gadam, a semi-dwarf sorghum variety with specific market traits, including white colour, low tannin and a high starch content. Originating in Sudan, Gadam was officially introduced in Kenya as a food crop in 1972 but then re-launched as an industrial crop in eastern Kenya in 2004. The KARI Seed Unit, located at Katumani, was established to grow and market seed of open-pollinated varieties (OPVs) that were unprofitable for private seed companies. It is the biggest producer of sorghum seed in Kenya. The Seed Unit sub-contracts seed production to 3000 growers who are advanced seed and repay in kind after harvest. The minimum acreage for a contract farmer is five acres. The Seed Unit buys whatever quantity farmers want to sell, provided it passes seed inspection by KEPHIS. Sales are made to large buyers but not to stockists because of risk of adulteration with inferior seed. In 2011, KARI bought 600 t of Gadam seed from contracted growers.

4.1.2 Sorghum growers

Sorghum is grown principally in semi-arid areas of Eastern, Nyanza and parts of Coastal region of Kenya. The crop performs well in areas of 500-1700 m above sea level (asl) with seasonal rainfall of 300 mm and above. In Eastern region production is concentrated in Kitui, Makueni and Machakos counties, Meru and Tharaka. Between 1990 and 2012 the trend in production was positive, but with large fluctuations, which reflected fluctuations in the area harvested. Since 2009, however, there has been a steady increase in production, primarily because of the growing demand for sorghum for brewing.

Figure 5: Value chain map for sorghum beer, Kenya

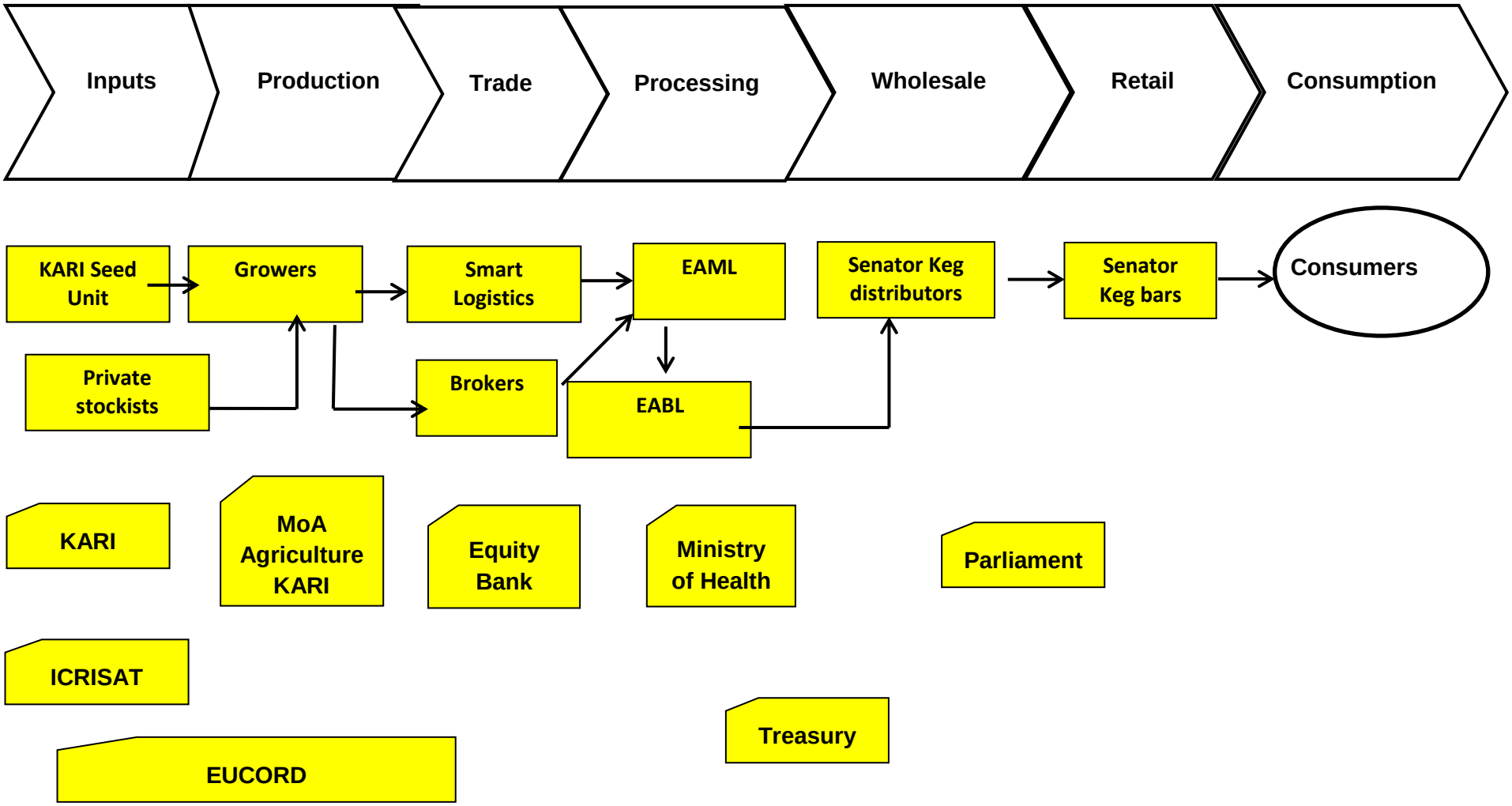
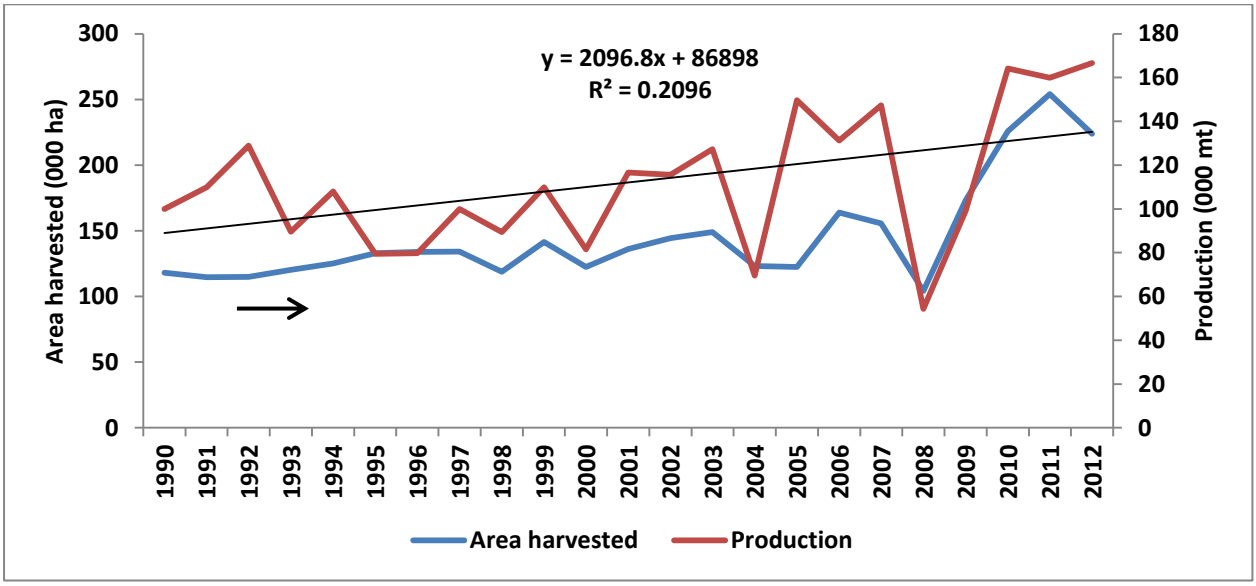


Figure 6: Sorghum production in Kenya, 1990-2012.



Source: FAOSTAT

4.1.3 Smart Logistics Solutions Ltd.

Smart Logistics Solutions Ltd. is a private Kenyan owned company established in 2006. In 2011, it purchased 2,000 t of Gadam sorghum, of which 1,500 t came directly from growers selling to aggregation centres and 500 t from its own appointed agents. Growers who use aggregation centres are paid by Equity Bank either through personal bank or M-pesa accounts. By contrast, agents pay on the spot and hence supplement the company's working capital. Sorghum from the aggregation centres is bulked at a central warehouse in Machakos before delivery to East Africa Maltings Limited (EAML). In 2102, Smart Logistics sourced sorghum from 1,500 small scale sorghum farmers organized into marketing groups.

4.1.4 East African Breweries Limited

The market for beer in Kenya is dominated by Kenya Breweries Ltd, a subsidiary of East African Breweries (EABL), which has an estimated 93 % market share. EABL is a subsidiary of Diageo plc (50% stake), while 50 % is state-owned through the Industrial and Commercial Development Corporation (ICDC). In the 2012 financial year, the brewer's sorghum demand reached 24,000 t, of which Kenyan growers supplied 8,000 t, with the balance met by imports. Sorghum sourced from farmers by Smart Logistics and other agents is delivered to EAML, one of the EABL Group of companies, which supplies quality raw materials for brewing.

4.1.5 Distributors

East African Breweries Limited appoints distributors who supply only their products. Each distributor serves a specific area. In order to differentiate Senator from EABL's premium brands, distributors for Senator keg and keg spirits do not distribute Tusker or Guinness. To qualify as a distributor for Senator keg and keg spirits, distributors must have a bank guarantee of KES 10 million and start-up capital of KES 10 million.

4.1.6 Retailers

Retailers selling Senator keg buy from the distributors and sell in 500 ml and 300 ml mugs. Customers are primarily low income earners in surrounding area. For the bar interviewed (Sky Pub bar), the main customers were mainly male casual workers, both old and young.

4.2 Value addition

4.2.1 Sorghum growers

Partial budgets for the 2012 growing season are shown in Table 3. Labour costs were calculated based on a wage rate of KES.250 per day for men, KES 200 for women, and KES 75 per day for children. Most sorghum growers used only family labour. First weeding, bird scaring and harvesting were the only activities for which farmers hired labour. Exchange labour was rarely used. Consequently, there was a big difference between the cash-cost of labour (1,120 KES/acre) and the full-cost (13,725 KES/acre). Bird-scaring was the single most important labour cost (41%). Farmers reported receiving seed for free, but the market rate for a 2 kg pack required for one acre was estimated at KES 375. No farmer reported applying fertilizer or pesticides to sorghum. Typically, most farmers used their own or borrowed donkeys to transport sorghum to the market or collection centres. For households living nearer the collection centres, women carried the sorghum on their backs.

Gross revenue was estimated at 6,250 KES/acre. On a cash-cost basis, the gross margin for sorghum was 4,755 KES/acre or 19 KES/kg. However, on a full-cost basis, the gross margin was -7,970 KES/acre or -0.56 KES/kg, showing that farmers lost half of every shilling invested. Value added (D) was calculated by the sales revenue which is the total value generated (A) less the cost of hired labour.

Table 3: Value added by Gadam sorghum growers, Kitui district, 2012 season (KES/acre)

(A) Sales Value	**Quantity**	**Unit**	**Price/unit**	**Total**
Yield	250	Kg	25	6250
(B) Inputs				
Seed	2.5	kgs	150	375
Fertilizer	0	0	0	0
Manure	0	0	0	0
Bags	3	number	40	120
Pesticides	0	0	0	0
(C) Other Inputs				
Labour	Family (mandays)	Hired (mandays)	Exchange (mandays)	Total
Land preparation- oxen	3	0	0	3
Land preparation-hoe	0	0	0	0
Manure application	0	0	0	0
Planting	1.6	0	0	1.6
Replanting	0	0	0	0
Fertilizer application	0	0	0	0
1st weeding	6.2	1	0	7.2
2nd weeding	3.6	0	0	3.6
3rd weeding	0	0	0	0
Spraying	0	0	0	0
Bird scaring	20.3	2	0	22.3
Harvesting	4.1	1	2	7.1
Carrying produce	1.6	0	1	2.6
Drying	0.8	0	0	0.8
Threshing	2.9	0	1	3.9
Winnowing	1.6	0	0	1.6
Bagging	0.4	0	0	0.4
Transporting to aggregation centre	0.8	0	0	0.8
Total labour hours	46.9	4	4	54.9
	Full-costs		Cash-costs	
Wages (labour costs)	13,725		1,120	
(D) Value added				
Value added per acre	6250		5130	
Value added per kg of grain	25.0		20.5	

Note: KES 85.0 = US $ 1

4.2.2 Smart Logistics

Table 4 shows value added by Smart Logistics. In the 2012 season, it bought Gadam at 25 KES/kg. Intermediate inputs included the cost of the raw material and operational services (transport). Smart Logistics added value of 5.5 KES/kg or 22% of the buying price. Profit was estimated at 2 KES/kg. Profitability therefore depended on high volumes.

Table 4: Value added by Smart Logistics (Oct-Dec, 2012) (KES/kg)

(A) Sales Value	
Price of sorghum grain	32
(B) Intermediate Goods	
Cost of Sorghum grain	25
Transport	1.0
Cess	0.5
Total	26.5
(C) Other Inputs	
(D) Value added	
Aggregation	1.0
Loading and offloading	1.0
Administration	1.0
Handling losses (pouring, weight loss)	0.5
Profit	2.0
Total Value added	5.5

Source: Smart Logistics Solutions Ltd.

Note: KES 85 = US $ 1

4.2.3 East African Breweries Limited

EABL buys Gadam sorghum from Smart Logistics and other suppliers at 32 KES/kg. One 50 litre barrel of sorghum beer is sold to distributors at 4,289 KES/barrel, giving a sale price of 86 KES/litre. EABL did not provide information on the cost of intermediate inputs or value added. One brew of sorghum beer (80,000 litres) requires 11 t of sorghum grains, so 1 kg of sorghum grain produces 7.27 litres of beer. Therefore, the cost of raw material to produce one brew is KES 352,000. The sale price of one brew is KES 6,862,400. The revenue from 1 kg of sorghum grain is therefore KES 624 (KES 6,862,400 /11t).

4.2.4 Senator Keg Distributors

Table 5 shows value addition for Senator keg distributors. In 2012, distributors bought a 50 litre keg for KES 2,780. After the imposition of excise duty in September, 2013, the price rose to KES 5,200 per keg. From January 2014, the price has dropped to KES 4,289 per keg. In 2012, the retail price was KES 3,040 per barrel. After the excise duty imposition it rose to KES 5,325, and currently one 50 litre barrel sells at KES 4,537. In 2012, Jukoma Enterprises bought 6,000 barrels per month. Since the imposition of excise duty, this has fallen to 900 barrels per month, representing an 85% drop in sales of Senator keg. Operation costs for Jukoma average 81,760 KES/month, with licenses paid annually. Distributors buy at KES 4289 per 50 litre barrel and sell at KES 4537. The value added was

KES 226 per barrel. To convert to sorghum grain, we converted to litres, and divided litres by 7.27, since 1 kg of sorghum grain gives 7.27 litres of sorghum beer.

Table 5: Value added by Senator keg distributors (KES)

(A)Sales Value		**Per 900 barrels**	**Per 50 litre barrel**	**Per kg of sorghum grain**
Revenue from Keg per month	900 barrels @ 4537	4,083,300	4537	660
(B) Intermediate Goods				
Cost of Keg purchase per month	900 barrels @ 4289	3,860,100	4289	624
- Liquor license		2500	2.77	0.38
- Council license		1000	1.11	0.15
- Health license		260	0.29	0.04
- Electricity		1500	1.67	0.23
- Petrol (transport)		14400	16.0	2.29
Total		3,879,760	4311	627.1
(C) Other Inputs				
(D) Value added				
Operation cost accrued by Senator keg per month (60% of total cost)				
- Labour		19200	2.11	0.29
- Rent		42000	46.7	6.42
- Truck maintenance		900	1.0	0.14
- Profit		141,440	157.2	21.62
Total Value Added		203,540	226.2	28.47

Note: KES 85=1USD

4.2.5 Senator keg retailers

Table 6 shows value added by Senator Keg retailers. In 2012 retailers used to sell a 300ml mug for KES 25 and a 500 ml mug for KES 40. After the imposition of excise duty the price rose to KES 35 for a 300 ml mug and KES 60 for a 500 ml mug. Before the imposition of excise duty, this bar sold 100 barrels per month; currently it sells only 30 barrels of Senator keg per month. Senator keg accounted for about 60 % of total sales. Retailers buy Senator keg from distributors at KES 4,537 per 50 litre barrel and sell at KES 5,000 per barrel. Most costs have either stayed constant or increased. Intermediate costs averaged KES 4,709 per 50 litre barrel. Value added averaged KES 291 per barrel, and profits were negative at KES -169 per barrel. To convert to sorghum grain, we converted to litres, and divided litres by 7.27, since 1 kg of sorghum grain gives 7.27 litres of sorghum beer.

Table 6: Value added by Senator Keg retailers (KES)

(A) Sales Value		Per 30 barrels 60% of total costs	Per 50 litre barrel	Per kg of sorghum grain
Revenue from Keg per month	30 barrels @ 5,000	150,000	5,000	727
(B) Intermediate Goods				
Cost of Keg purchase per month	30 barrels @ 4,537	136,110	4,537	660
- Liquor license		1500	50.0	7.27
- Health license		215	7.17	1.04
- Council license		210	7.00	1.02
- Electricity		900	30.0	4.36
- Water		1800	60.0	8.72
- Transport		540	18.0	2.62
- Total		141,275	4709	684.7
(C) Other Inputs				
(D) Value added				
- Labour		4800	160.0	23.26
- Rent		9000	300.0	43.62
- Profit		-5,075	-169.2	-23.27
Total value added		8725	290.8	43.61

Source: Sky Pub bar, Kiambu, Nairobi. Note: KES 85=1 USD

4.2.6 Value addition for sorghum beer

Figure 7 shows value addition for the value chain for sorghum beer. To compare the benefits received by different actors, value addition is expressed per kg of sorghum grain. Brewing adds the most value to sorghum grain. EABL buys one kg of sorghum at 32 KES/kg and after transformation into beer the same kg of sorghum sells for 624 KES/kg. Consequently, the share of value added is unequally distributed. Sorghum growers receive 3 % of final price. The lion's share accrues to brewers, distributors and retailers, with EABL receiving 81 %. Growers do better in terms of profitability, making 21 Ks/kg or 84 % of the sale price. We cannot estimate profitability for EABL, since brewing costs are not known. However, profits may not be excessive given intermediate costs and the cost of wages. Profitability is negative for Senator bars reflecting the price rise that followed the imposition of excise duty.

4.3 Challenges faced by value chain actors

4.3.1 KARI Seed Unit

- Large carry over stock due to decline in demand, owing to end of MoA's "Orphan Seed Programme"; and
- Adulteration by traders who mix seeds from KARI with other seeds.

4.3.2 Smart Logistics Solutions Ltd.

- Risks of drought which make farmers to keep the little sorghum they have harvested for home consumption;
- Competition from spot buyers;
- Mistrust where some farmers felt they would not be paid; and
- High cost of trade finance for buying sorghum.

4.3.3 East African Breweries

- More raw materials required for sorghum beer brewing (sugar, and yeast) because of low carbohydrates in sorghum as compared to barley;
- Yeast in sorghum cannot be re-used as in barley; and

Sorghum has a 'recognizable taste' and as a result it is used in only one brand (Senator keg). The other beer brands are brewed with barley. EAML, a subsidiary of EABL mandated in sourcing raw materials for brewing identified the following as their main challenges:

Figure 7. Distribution of revenue and value along the value chain for sorghum beer in Kenya (per kg of sorghum grain)

Function	Production	Bulking/ Transport	Processing	Distribution	Retail sale
Actor	*Farmers*	*Smart Logistics*	*EABL*	*Distributors*	*Bars*
Price received (KES/kg of sorghum)	25	32	624	660	727
Share of final price	3 %	1 %	81%	5 %	9 %
Intermediate goods (KES/kg)	Nil	Sorghum grain: 25 Transport: 1.0 Cess: 0.5 Total: 26.5	Sorghum grain: 32 Sugar: NA Water: NA Bottles: NA Caps: NA Other ingredients: NA	Sorghum grain: 624 Liquor licence: 0.38 Council licence: 0.11 Health licence: 0.04 Electricity: 0.23 Petrol: 2.29 Total: 627.1	Sorghum grain: 660 Liquor licence: 7.27 Council licence: 1.04 Health licence: 4.36 Electricity: 8.72 Petrol: 2.62 Total: 684.7
Value addition (Kes/kg)	Hired labour : 4.0 Profit: 21.0 Total 25.0	Wages: 3.0 Handling losses: 0.5 Profit: 2.0 Total: 5.5	Wages: NA Rent: NA Interest: NA Depreciation: NA Profit: NA	Wages: 0.29 Rent: 6.42 Truck repair: 0.14 Profit: 21.62 Total: 28.47	Wages: 23.26 Rent: 43.62 Profit: -23.27 Total: 43.61
Intermediate costs (%)	0 %	83 %	NA	95 %	94 %
Value added (%)	100 %	17 %	NA	5 %	6 %

Note: KES 85 = 1 USD

- Unable to source enough sorghum from Kenya, and high import costs due to import taxes;
- Poor quality of sorghum from some farmers; and
- Have to work with small-scale farmers who face agronomic disadvantages (bird scaring, spacing, and weeding).

4.3.4 Senator keg distributors

Major challenges mentioned by the distributors arise from the imposition of excise duty in September 2013:

- Low sales volumes, with decrease of 85 % in volume of sales;
- Have had to retrench some staff;
- Some bars have closed down or stopped selling Senator keg;
- High cost of doing business and lack of access to credit due to high interest rates; and
- Difficulties delivering Senator keg during the wet season because access roads to bars are impassable.

4.3.5 Senator keg retailers

- Low sales volume after the price increase;
- Confrontations when customers refuse to leave the bar at the new closing time of 2200 hrs;
- Retrenchment of staff; and
- High cost of liquor licenses.

4.3.6 Growers

Smart Logistics groups reported their main problem as the length of time required for payment (37 %), followed by low buying price (26 %) (Table 7). Although Smart Logistics offers a higher price than other buyers, members felt the buying price did not compensate for the labour required to grow sorghum, particularly since most operations are done by hand. This is clearly linked to the third most important problem of 'no threshing machine' (19 % of growers). Although the labour required for threshing (3.9 mandays/acre) is less than required for weeding or bird-scaring (Table 3), the operation is dusty and unpleasant.

Table 7: Problems reported by members of Smart Logistics Groups

Problem	Weighted Frequency	Weighted (%)
Payment takes too long	37	28.0
Buying price is too low	34	25.8
No threshing machines	25	18.9
Gadam seeds arrive late	10	7.6
The collection centres are too far away	7	5.3
Not enough training on sorghum production	7	5.3
High charges for payments though bank or Mpesa	4	3.0
Have to buy sacks from Smart Logistics	4	3.0
Gadam seeds are poor quality	2	1.5
Others	2	1.5
Smart Logistics did not return our sacks	1	0.8
Total	132	100

Table 8 provides more information on time of payment. Only 5% of farmers were paid within the target of one week set by Smart Logistics. The majority of farmers (37%) were paid after four or five weeks, while a minority (6.1%) had to wait three months. The average waiting time was 4.5 weeks. This explains why 'payment takes too long' was ranked as the most important problem for growers selling to Smart Logistics (Table 7). The most popular method of payment was by 'Own Mpesa account' [9] used by 24 % of group members. Although Smart Logistics encourages members to have their own bank or Mpesa accounts, 64 % of members were paid in cash or through second party accounts. This highlights the importance of trust, which was cited as an important criterion for group membership.

Table 8: Timeliness and mode of payment (n=115)

Payment after delivery (weeks)	Frequency	Percent	Method of payment	Frequency	Percent
1	5	4.3	Own Mpesa account	27	23.5
2-3	30	26.1	Bank account of another group member	23	20
4-5	43	37.4	Group bank account	19	16.5
6-7	17	14.8	Own bank account	17	14.8
8-9	7	6.1	Cash	12	12.2
10-11	4	3.5	Mpesa account of another group member	11	10.4
12	2	1.7	Bank account of other relative	5	4.3
Not paid	7	6.1	Spouse's bank account	1	0.8
Total	115	100.0	Total	115	100.0

[9] A mobile-phone based electronic money transfer and micro-financing service. It comes from the Kiswahili word 'pesa' meaning money.

5. The grower survey

5.1 Socio economic profile

Although Smart Logistics works primarily with groups, non-members (20%) also sold Gadam through a Smart Logistics group. We divided the sample households into three groups for analysis: members of Smart Logistics groups, non-members of Smart Logistics groups who sell sorghum, and non-members who do not sell sorghum. The rationale for this grouping is that a high proportion of households that were not group members nevertheless sold sorghum through a Smart Logistics group, using a friend or relative to make the sale.

Table 9 provides a socio-economic profile of these three household groups. No significant differences were found in household characteristics (female heads, age, household size, number of adults and children, and education) between the three groups. However, members owned significantly more land *per capita* (1.52 acres) than non-members. Non-member sellers had the smallest own land per capita (0.95 acres) and to compensate borrowed or rented-in more land (1.36 acres) than others.

As expected, the area planted to sorghum was significantly higher for members (1.71 acres), but the area planted to maize did not differ significantly across the groups. Unexpectedly, sorghum production was highest among non-members sellers (688 kg/household) compared to 483 kg/household for members. Likewise, the quantity of sorghum sold was also highest among non-member sellers (517 kg/household) compared to 305 kg/household for members. There were a few members who did not sell their sorghum in the last season, which could be the reason why the sorghum sold per household for members was lower than for non-members. There was no significant difference in adult participation rate in sorghum production between the groups.

Household income from crops was significantly higher for non-member sellers compared to the other two groups (66,641 KES/household compared to 48,679 KES/household for members and 42,834 KES/household for non-sellers).There were no significant differences in other household incomes across the three categories; neither were there significant differences in the asset values.

Significantly more non-member sellers (83%) bought maize as compared to members' and non-members non-sellers. Likewise, the average number of months that a household purchased maize was higher for the non-member sellers (5.9 months) compared to 5.6 months for non-members non-sellers and 4.9 for the members. Group members bought maize less frequently because they kept more maize to eat (725.3 kg/household), compared to 315 kg/household and 405 kg/household for non-member sellers and non-member non-sellers, respectively.

Table 9: Socio-economic profile of sorghum growers

Variable	Members (n=150)	Non members		Sig. Level (p<)
		Sellers (n=75)	Non sellers (n=72)	
Household characteristics				
Female headed households (no.)	63 (42.0)[a]	39 (52.0)	51 (70.8)	0.275
Age of household head (no.)	53 (14.3)[b]	50 (14.6)	50 (15.6)	0.263
Schooling of household head (years)	7.0 (4.4)	6.5 (4.0)	6.6 (4.9)	0.728
Household size (no.)	6.5 (2.71)	6.3 (2.13)	6.2 (2.14)	0.531
Adult members <15yrs (no.)	3.9 (1.64)	4.3 (1.63)	3.9 (1.64)	0.389
Children >15yrs (no.)	2.2 (0.55)	2.2 (1.66)	2.5 (1.74)	0.545
Land (acres)				
Owned land per capita	1.52 (2.4)	0.95 (0.82)	1.50 (2.06)	0.090*
Land cultivated	5.17 (4.13)	5.00 (4.21)	4.65 (3.94)	0.722
Borrowed/rented in land	0.92 (1.75)	1.36 (2.69)	0.65 (1.34)	0.080*
Household food security				
Households purchasing maize (no.)	117 (78.0)	62 (82.7)	53 (73.6)	0.036**
Months buying maize (no.)	4.85 (3.6)	5.9 (3.0)	5.60 (4.1)	0.086*
Maize kept to eat (kg)	725 (676)	315 (367)	405 (40)	0.095 *
Households purchasing sorghum (no.)	20 (13.3)	7 (9.3)	14 (19.4)	0.314
Months buying sorghum (no.)	0.67 (2.17	0.95 (2.52)	0.42 (1.44)	0.317
Sorghum kept to eat (kg)	281 (322)	108 (40)	79 (23)	0.265
Cereal production				
Sorghum production (kg)	483 (652)	688 (2519)	107 (134)	0.033**
Area planted to sorghum (acres)	1.71 (1.73	1.33 (1.46)	0.82 (1.03)	0.000***
Sorghum sold (kg)	305	517	0	0.043**

	(601)	(2344)	(0)	
Maize production (kg)	899	722	703	0.377
	(1386)	(623)	(973)	
Area planted to maize (acres)	2.43	2.53	2.55	0.876
	(1.87)	(1.76)	(1.95)	
Adults (>15yrs) full time in sorghum production	1.97	1.76	1.85	0.416
(no.)	(1.13)	(1.26)	(1.00)	
Households that have increased area planted	90	33	31	0.004***
to sorghum (no.)	(60.0)	(44.0)	(43.1)	
Income (000 KES)				
Crops	48.7	66.6	42.8	0.067*
	(49.7)	(10.1)	(46.8)	
Livestock	150.1	125.2	165.9	0.353
	(170.5	(171.4)	(181.1)	
Off-farm	72.4	67.0	102.5	0.290
	(122.8)	(98.8)	(229.6	
Total	271.2	258.8	311.2	0.560
	(262.5)	(336.3)	(378.6)	
Income per capita	49.4	45.6	54.8	0.638
	(58.5)	(50.8)	(68.5)	

Notes:
a Percentages for numerical variables, Chi-square test for categorical variables
b standard deviation for quantitative variables, ANOVA for continuous variables
* 0.1 significance level, **0.05 significance level, ***0.01 significance level

5.2 Sorghum production

Only 51 % of fields planted to sorghum followed the recommended method of planting Gadam in pure stand. Forty-nine percent of fields planted to sorghum were intercropped either with green grams (35 %), cowpeas (28 %), maize (16 %) or pigeon peas (13%). Half the sample growers had increased the area planted to sorghum. The main reason reported for the increase in area was ‘to increase income’ (Table 10).

Table 10: Reasons for increasing area planted to sorghum (%)

Reason	Members (n=90)	Non-members		Total (155)
		Sellers (n=33)	Non-sellers (n=31)	
To increase income	28	24	32	27
To increase production	24	21	29	25
Sorghum is high yielding	16	9	13	14
Sorghum is profitable	16	18	7	14
Sorghum is reliable	7	18	3	8
Sorghum is drought resistant	7	9	0	6
Use sorghum for food	4	0	16	6
Total	100	100	100	100

Chi-square $p = 0.113$

Of the growers who reported no increase in the area planted to sorghum, 39 % claimed this was due to a shortage of land for cultivation, followed by not enough labour (32 %) (Table 11). However, for non-sellers, the main constraint (43 % of growers) was not shortage of land but shortage of labour. Non-sellers were also more likely to report sorghum cultivation as unprofitable (37%).

Table 11: Reasons for not increasing area planted to sorghum (%)

Reason	Non-members		Members (n=60)	Total (n=143)
	Sellers (n=42)	Non-sellers (n=41)		
Not enough land	43	17	50	39
Not enough labour	26	43	27	32
Not profitable	29	37	20	27
High cost of seed	0	0	2	1
Poor/unfavorable rains	2	0	2	1
Total	100	100	100	100

Chi-square $p = 0.05$

Scope for expanding the area planted to sorghum was limited by the need to grow maize and other crops for food security and cash income. Half of the sampled sorghum growers (51%) estimated the frequency of poor maize harvests at four years out of five while 33%

estimated this at three years out of five. In years when maize did not do well, households used several coping strategies. More than half of the households reported selling livestock or green grams, or relied on remittances from family members working in town. Fifty two percent of members used selling sorghum as a coping strategy after a poor maize harvest, compared to 21 % of non-members.

Preferences for sorghum and maize were elicited by asking growers if they agreed or disagreed with certain statements (Table 12). Eight in 10 growers agreed that in drought years sorghum gave a higher yield than maize. Moreover, only one-third of growers believed that in a normal year maize gave higher yields than sorghum. Why then did growers persist in growing maize? The main reasons included taste (for both adults and children), ease of selling maize, and that maize needed less labour. Moreover, maize was always there in the market. Households that run out of food have no choice but to buy maize, which increases the incentive to plant maize to avoid forced maize purchases. Interestingly, sorghum non-sellers believed that maize was easier to sell than sorghum.

Table 12: Maize and sorghum preferences

Number agreeing that:	Members (n=150)	Non- members		Sig. Level (p<)
		Sellers (n=75)	Non sellers (n=72)	
Maize is always there in the market	115 (76.7%)	63 (84%)	60 (83.3%)	.317
Maize is cheaper to buy than sorghum	20 (13.3%)	12 (16%)	8 (11.1%)	.685
In a normal year, maize gives a higher yield than sorghum	35 (23.3%)	24 (32%)	21 (29.2%)	.011**
In a drought year, sorghum gives a higher yield than maize	121 (80.7%)	63 (84%)	60 (83.3%)	.791
Maize needs less labour than sorghum	91 (60.7%)	62 (82.7%)	45 (62.5%)	.003***
Maize gives food earlier than sorghum	21 (14%)	8 (10.7%)	16 (22.2%)	.127
Maize has a higher sale price than sorghum	83 (55.3%)	45 (60%)	52 (72.2%)	.054*
Maize is easier to sell than sorghum	99 (66%)	48 (64%)	58 (80.6%)	.050**
Maize tastes better than sorghum	108 (72%)	67 (89.3%)	67 (93.1%)	.000***
My children prefer *ugali* made from maize	109 (72.7%)	65 (86.7%)	68 (94.4%)	.000***
My children prefer *uji* made from sorghum	10 (6.7%)	1 (1.3%)	4 (5.6%)	.221

* 0.1 significance level, **0.05 significance level, ***0.01 significance level

The main labour constraint on sorghum cultivation was bird-scaring (60 %) followed by threshing (30 %) (Table 13). Bird scaring was conducted for two-three weeks from dawn to dusk before harvesting. The methods used have not changed for 100 years. Platforms are built that give a good view of the crop. Wires strung with empty tins are strung across the field, and pulled when birds appear. All categories cited threshing as the second most labour-intensive sorghum production activity. Threshing is labor-intensive because few farmers have access to threshing machines. Threshing was usually done at night to minimize exposure to direct sunlight which causes skin irritation. Among Smart Logistics groups with access to a threshing machine, some set a minimum production threshold (eg. 500 kg) for growers who requested access to the machine.

The biggest problem is bird scaring, forcing farmers to plant a smaller area they can protect effectively. Since there is no cash to hire labour, members have to use family labour. Scaring is done mostly by adults since children are at school. Normally they have to scare birds for 3-4 weeks per season, a full day from dawn to dusk. Birds are scared by stringing tin on wires that are stretched across the field; building platforms so that bird-scarers can see birds; hanging rags in the field; and by firing catapults. Birds eat less of the red sorghum, but they prefer Gadam, which is sweet. Kanduti Farmers Field School (March 2013).

Table 13: Labour constraints in sorghum production (%)

Activity	Non-members		Members (n=150)	Total
	Sellers (n=75)	Non-sellers (n=72)		
Scaring birds	57	76	54	60
Threshing	33	18	34	30
Weeding	5	1	7	5
Harvesting	4	3	3	3
Ploughing	0	1	2	1
Total	100	100	100	100

Chi-square $p = 0.110$

Weeding is a labor-intensive activity that must be completed within six weeks of planting. Weeding for both sorghum and maize was done chiefly with family labour (Table 14). No significant differences were found between the type of labour used to weed sorghum and maize, or between the type of labour for weeding used by members and non-members.

Table 14: Labour use for weeding sorghum and maize (%)

Type of labour	Sorghum			Maize		
	Members (n=148)	Non-members (n=134)	Total (n=280)	Members (n=148)	Non-members (n=146)	Total (n=294)
Family labour only	58	63	60	57	62	60
Hired labour only	5	5	5	1	3	2
Both family and hired	30	29	30	32	31	32
Exchange labour	3	2	3	3	1	2
Family and exchange labour	2	2	2	6	2	4
Family, hired and exchange labour	1	0	1	0	1	0
Total	100	100	100	100	100	100

Chi-square $p = 0.140$ (maize), $p = 0.675$ (sorghum)

Table 15 compares crop management practices between members and non-members for sorghum and maize. We found few significant differences for sorghum. Since training

provided at the group demonstration plots is open to non-members, most growers know the recommended agronomic practices. None of the growers applied fertilizer because most believed that their fields had good soil fertility. However, non-members weeded sorghum more frequently than members (1.98 weedings compared to 1.88). They also weeded maize more frequently (2.08 times compared to 1.99). This may reflect labour shortage caused by the greater area that members planted to sorghum (Table 9). Members were more likely to plant sorghum on terraced fields (83 % compared to 71%). Maize was more likely than sorghum to be planted before the rains, and more likely than to be planted on fields considered to have good soil fertility.

Table 15: Crop management practices for sorghum and maize

Practice	Sorghum			Maize		
	Members (n=146)	Non-members (n=134)	Sig.-level (p <)	Members (148)	Non-members (146)	Sig.-level (p <)
Planted before rains (% fields)	46 (31.5%)	47 (35.1%)	0.676	57 (38.5%)	61 (41.8%)	0.369
Line planting (% fields)	97 (66.4%)	99 (73.9%)	0.686	97 (65.5%)	99 (67.8%)	0.349
Applied fertilizer (% fields)	0	0	-	1	1	0.505
Applied manure (% fields)	40 (27.4%)	40 (29.9%)	0.985	42 (28.4%)	42 (28.8%)	0.906
Weedings (no.)	1.88	1.98	0.075*	1.99	2.08	0.042**
Terraced field (%)	83 (56.8%)	71 (53%)	0.035**	80 (54.1%)	73 (50%)	0.279
Own field (%)	88 (60.3%)	91 (67.9%)	0.489	60 (40.5%)	60 (41.1%)	0.251
Fields reported to have good soil fertility (%)	52 (35.6%)	56 (41.8%)	0.529	86 (58.1%)	89 (61%)	0.435

* 0.1 significance level, **0.05 significance level, ***0.01 significance level

Table 16 shows the type of soils in sorghum fields among members and non-members, respectively. Members were significantly more likely to plant sorghum on fields with sandy soil (38%) while non-members were more likely to plant sorghum on red soils (36 %). No significant differences were found for maize.

Table 16: Soil type on fields planted to sorghum and maize (%)

Type of soil	Sorghum			Maize		
	Members (n=146)	Non-members (n=134)	Total (n=280)	Members (n=148)	Non-members (146)	Total (n=297)
Sandy	38	24	26	28	21	24
Red soil	27	36	30	22	35	28
Black soil	19	28	35	33	34	34
Murram (stony or rocky soil)	13	8	9	10	5	7
Sandy and red soil	0	2	2	2	1	2
Red and black soil	1	2	3	2	3	2
Sandy and black soil	3	2	2	3	1	2
Total	100	100	100	100	100	100

Chi-square: $p = 0.063$ (sorghum), $p = 0.137$ (maize)

5.3 Utilization of sorghum

Table 17 shows the main uses of sorghum and maize. Households used maize primarily for food security (63 %), while 36 % reported that some maize was sold. By contrast, the majority of sorghum growers (63%) reported using sorghum for both food and for sale, while only 11 % of growers reported that sorghum was mainly used as food. The dual use of sorghum highlights its importance as a food security crop in drought years when the maize harvest fails.

Table 17: Main uses of sorghum and maize (%)

Main use	Sorghum				Maize			
	Members (n=150)	Non-members			Members (n=150)	Non-members		
		Sellers (n=75)	Non-sellers (n=72)	Total (n=297)		Sellers (n=75)	Non – sellers (n=72)	Total (n=297)
Food security	11	19	61	25	65	56	31	63
Cash income	15	13	0	11	0	1	1	1
Both food security and cash income	74	68	25	61	35	43	16	36
Feeding chickens	1	0	14	4	0	0	0	0
Total	100	100	100	100	100	100	100	100

Chi-square $p = 0.000$ (sorghum), $p = 0.226$ (maize)

Table 18 shows sales channels for Gadam sorghum for the 2012 season short rains. (Red sorghum accounted for only 2 % of sorghum sold, while no growers reported sale of white sorghum). The share of households selling exceeds 100 % since some growers sold through more than one channel. The majority of both members (86 %) and non-members (32 %) sold sorghum to Smart Logistics. Side-selling was rare among group members (14 %). Among non-members, half sold to Smart Logistics through collection centres or brokers. Smart Logistics collection centres offered the highest price for sorghum (25 KES/kg), while the lowest prices were offered by traders in local markets (19 KES/kg) and local shopkeepers (17 KES/kg). The prices paid by traders from outside Kitui district (22 KES/kg) were competitive with the price offered by Smart Logistics brokers (22 KES/kg) who collected sorghum at the farm gate and paid growers immediately and in cash. This may explain why non-members sold the highest average volumes (588 kg) to brokers from outside the district. The average volumes were calculated with respect to the number of households who sold through a specific channel. Members sold an average of 342 kg through Smart Logistics compared to 189 kg for non-members. For households selling Gadam the average volume sold was 314 kg/household for members and 198 kg/household for non-members. On average, the member of a Smart Logistics group selling to a Smart Logistics collection centre in 2012 sold 342 kg of sorghum at a price of 25 KES/kg, earning KES 8,550 from sorghum sales.

Table 18: Sales channels for Gadam sorghum, Short Rains Oct-Dec 2012 (%)

Sales channel	Price (KES/ kg)	Households selling Gadam (no.)		Average quantity of Gadam sold (kg)*	
		Members (n=123)	Non-members (n=66)	Members (n=123)	Non-members (n=66)
Smart Logistics collection centre	25.0	106 (86.2%)	21 (31.8%)	342	189
Smart Logistics broker	23.0	4 (3.3%)	11 (16.7%)	160	202
Broker from outside the district	22.0	5 (4.1%)	9 (13.6%)	68	588
Schools	20.0	0	8 (12.1%)	0	70
Other villagers/ consumers	19.5	3 (2.4%)	3 (4.5%)	15	65
Traders in local markets	19.0	5 (4.1%)	14 (21.2%)	118	99
Local shopkeeper	17.0	4 (3.3%)	3 (4.5%)	130	73
Average volume sold per household				314*	198

** The figure for average volume sold differs from that in Table 9, which includes both sellers and non-sellers over both the Short and Long Rains in 2012.*

5.4 Uses of sorghum income

School fees and materials (uniforms, textbooks) were ranked as the most important use of income from sorghum (weighted frequency 44 %), with buying food and goats ranked second and third, respectively (Table 19). Investing in children's education is important for women since they do not own land and children are viewed as a source of security in the event of separation or divorce. Goats function as a 'bank' since they are easily disposable. When households acquire income from sorghum sales, they buy goats which are later sold to buy inputs or meet pressing household needs.

Table 19: Uses of income from sorghum

Use of income	Weighted Frequency (no.)	Weighted (%)
School fees and school materials	83	43.5
Household food needs	44	23.0
Goats	15	7.9
Family health	8	4.2
Settling debts	5	2.6
Buying farm inputs	8	4.2
Terracing and ploughing	3	1.6
Investing in a shop	5	2.6
Others	20	10.5
Total	191	100.0

Though necessarily subjective, 83 % of group members perceived an improvement in their economic conditions since 2009, with 68% of non-member sellers and 71 % of non-member non-sellers reporting the same. Paradoxically, the average income from crops and sorghum sales were highest among the non-member sellers, yet it was this group that felt that there had been least improvement in their economic condition.

Annual university/college fees per child were highest among the group members (17,666 KES/year) compared to 2253 KES/year for non-member sellers and 3560 KES/year for non-members non-sellers (Table 20). Non-members non-sellers had significantly more children attending school (3.3). Primary school fees per child were significantly higher for non-members sellers (4145 KES/year) compared to group members (1893 KES/year) and non-members and non-sellers (989 KES/year). The use of sorghum income for school fees may reflect the economic insecurity of women, who are vulnerable in the case of widowhood and divorce because they cannot own land or other assets, which belong to their husband. For women, investment in children's education offers a 'retirement package' and some hope of economic security in the future.

Table 20: Investment in assets and education

Assets (000 KES)				
Total value of assets (KES)	125	113	113	0.749
	(138)	(175)	(686)	
Value of assets purchased since 2009 (KES)	290	249	390	0.165
	(457)	(416)	(537)	
School attendance and fees				
Children attending school (no.)	2.6	3.0	3.3	0.014**
	(1.84)	(1.60)	(2.11)	
Children in secondary school and college (no.)	0.79	0.73	0.77	0.904
	(0.96)	(0.89)	(0.92)	
University fees per child (KES/year)	17.7	2.3	3.6	0.017**
	(60.9)	(9.0)	(15.2)	
Secondary school fees per child (KES/year)	11	14	12	0.470
	(18)	(25)	(17)	
Primary school fees per child (KES/year)	1.9	4.1	0.9	0.002***
	(4.3)	(9.5)	(1.9)	
Total expenditure on school fees (KES/year)	32	51	35	0.362
	(56)	(153)	(65)	

* 0.1 significance level, **0.05 significance level, ***0.01 significance level

6. Social Inclusion

"Social inclusion" measures the participation in the value chain by growers that may be otherwise excluded by virtue of poverty, gender, or lack of resources. An inclusive value chain can be defined in at least two ways:

The value chain is *neutral* with regard to inclusion. In this case, disadvantaged households have an *equal* chance of participating in the value chain, and we would expect to find no significant differences in wealth indicators between participants.

The value chain is *biased* with regard to inclusion, favouring disadvantaged households. In this case, disadvantaged households have a *higher* chance of participating in the value chain than others, and we would expect to find significant differences in wealth indicators between participants.

For any given value chain, therefore, we can expect to find that some inclusion indicators are neutral while others show a bias towards disadvantaged households.

Information on the selection criteria for group members was obtained from three Smart Logistics clusters (Table 21). Generally, the cluster leaders agreed on the three most important selection criteria, although not on their order of importance. 'Ability to pay the membership fee' and 'quantity of sorghum for sale' can be described as objective 'threshold' criteria that households had to meet before being considered for membership. Membership fees ranged from 10 KES/week to 100 KES/month. For example, the members of Kanduti Farmers Field School paid a registration fee of just Ks 100 ($1.1). Similarly, the Maliku Cereal Growers cluster recommended that prospective members should be able to sell at least one 90 kg bag of Gadam sorghum. Other variables were more subjective and related to commitment and willingness to follow group norms. 'Reputation of the household' and 'full-time farmer' belonged in this category. Both are important for group cohesion, which helps determine the overall performance of the group.

Table 21: Criteria for membership to Smart Logistics Groups

Name of Cluster	Criteria 1	Criteria 2	Criteria 3
Maliku Cereal Growers	Quantity of sorghum for sale	Reputation and behavior of the household	Household head is full time farmer
Kanduti Farmers Field School	Ability to pay membership fee	Reputation and behavior of the household	Quantity of sorghum for sale
Kawongo Cereal Growers	Reputation and behavior of the household	Relative/friend	Ability to pay membership fee

Source: interviews with cluster leaders.

The inclusiveness of the value chain for sorghum beer was estimated by identifying inclusion indicators and estimating their importance in determining membership of a Smart Logistics group. Membership was hypothesised to depend on 10 independent variables (Table 22). All 10 variables may be regarded as indicators of inclusion. Besides obvious indicators such income, sex of the household head, land ownership, dependency ratio, and maize

purchases, we also included a dummy variable for full-time farmer, and the distance from a Smart Logistics collection centre (TIME_CENTRE).

Table 22: Definition of variables used in regression analyses

Variable	Definition	Expected sign (biased towards inclusion)
Dependent variables		
CATEGORY	1, If household is a member; 2, if household is non-member seller and 3, if household is non-member non seller	
SLMEMBER	1, If household is a member, 0 otherwise	
Independent variables		
TIME_CENTRE	Walking time to Smart Logistics collection centre (minutes)	_
FHH_DEFACTO	1 if de facto household head is female, 0 otherwise	+
HHAGE_SQ	Age of household head, squared	+
TOTSCHOOL	Formal schooling of household head (years)	-
DEP_RATIO	Dependency ratio (family size/members under 15)	+
MAIZE_PURCHASE	Months that household bought maize in 2012 (no.)	+
OCCUP	1 if household head is full-time farmer, 0 otherwise	+
OWN_PCAP	Land owned per family member (acres)	-
OWN_PADULT	Land owned per adult (acres)	-
INCOME_PCAP	Household income per capita (000 KES)	-

Two regressions were estimated. The first estimated determinants of Smart Logistics group membership (SLMEMBER) using binary logistic regression. The second used multinomial logistic regression to compare the determinants for members, non-member sellers, and non-member non-sellers (CATEGORY).

Logistic regression

Table 23 shows estimation results for the logistic regression. The significance test for the model Chi-Square (384.648) was statistically significant at the 1 % level (p > 0018), suggesting that the model gave a reasonable fit. The model correctly predicted 61 % of the cases.

Table 23: Determinants of membership of Smart Logistics group (SLMEMBER = 1)

Variables	Coefficient	Sig. level (*p*>)	Odds ratio
Intercept	-2.1522	0.002	
TIME_CENTRE	-8.65e-06	0.999 ns	1.000
FHH_DEFACTO	0.6186	0.023 **	1.856
HHAGE_SQUARED	0.0002	0.010 **	1.000
TOTSCHOOL_YEARS	0.1148	0.004 **	1.121
DEP_RATIO	0.2345	0.054 **	1.264
MAIZE_PURCHASE	-0.0988	0.005 **	0.905
OCCUP	0.6742	0.019 **	1.962
LAND_PCAP	0.3140	0.030 **	1.368
LAND_PADULT	-0.1218	0.036 **	0.885
INCOME_PCAP	-0.0021	0.393 ns	0.997
N = 297			
Log likelihood	27.05		
Prob > Chi square	0.0026		
Pseudo R^2	0.0657		
Cases correctly classified	60.94 %		

* 0.1 significance level, **0.05 significance level, ***0.01 significance level, ns not significant

Table 23 shows that eight of the 10 independent variables were statistically significant at the 0.05 % level or above.

The coefficient for FHH_DEFACTO was positive and statistically significant, indicating that households where the head was female were more likely to be group members. The odds of a FHH_DEFACTO household belonging to a Smart Logistics group are almost two times higher (1.9) than where the head is a man. The coefficients for HHAGE_SQ and SCHOOL were also positive and significant, indicating that when other variables are controlled for, members of Smart Logistic groups are more likely to be older and have more years of formal schooling. Member households also have significantly higher dependency ratios (DEP_RATIO), meaning that adults must support more children. The coefficient for OCCUP was positive and statistically significant. Full-time farmers were twice as likely to belong to a Smart Logistics group. As we have seen (Table 20), one Smart Logistics cluster used this as a criterion for group membership. Interestingly, the coefficient for INCOME_PCAP was negative but not statistically significant, indicating that income was not an important determinant of group membership. Finally, the LAND_PCAP and LAND_PADULT variables were both statistically significant, but with opposite signs. Households with higher owned land per capita were more likely, and households with less land per adult were less likely to be group members. This may reflect the fact that households with more land per head were more likely to have land available for sorghum cultivation, while those with less land per adult were more likely to have occupations other than farming. One surprising result was the indicator for household food security (MAIZE_PURCHASE), where group members were significantly *less* likely to buy maize. However, this may be explained by the need for poorer households to conserve as much maize as possible for home consumption in order to avoid buying in the hungry months when prices are highest.

Why are poorer households more likely to join Smart Logistics groups? One explanation is that they have fewer opportunities to earn cash income. As we noted, sellers have fewer livestock assets. By contrast, better-off households invest in livestock which provides a major source of income. Poorer households may find it more difficult to save and buy livestock, while the need to conserve maize for home consumption limits their ability to earn cash. By contrast, sorghum requires no cash investment except for seed, which can be accessed on credit and repaid after harvest. Second, poorer households have more time available to attend frequent group meetings. Among member households, men usually delegated attendance at group meetings to their wives. Finally, poorer households may have a higher preference for growing sorghum either on grounds of taste, or as a source of food security in years when maize does not do well.

Multinomial logistic regression

The significance test for the model Chi-Square was statistically significant at the 10 % level, suggesting that the model gave a reasonable fit (Table 24).

Table 24: Determinants of membership of Smart Logistics group (CATEGORY) (reference group= member)

Variables	Panel 1 Non-members, sellers			Panel 2 Non-members, non-sellers		
	Coefficient	Sig.-level ($p >$)	Odds Ratio	Coefficient	Sig.-level ($p >$)	Odds Ratio
Intercept	1.0174	0.214		1.8651	0.023	
TIME_CENTRE	0.0021	0.564 ns	1.002	-0.0029	0.504 ns	0.997
FHH_DEFACTO	-0.4407	0.172 ns	0.643	-0.8194	0.016 **	0.440
HHAGE_SQ	-0.000	0.115 ns	0.998	-0.0003	0.009 **	0.999
TOTSCHOOL	-0.0832	0.080 *	0.920	-0.1458	0.003 **	0.864
DEP_RATIO	-0.2107	0.203 ns	0.809	-0.2091	0.167 ns	0.811
MAIZE_PURCHASE	0.1083	0.012 **	1.114	0.0919	0.032 **	1.096
OCCUP	-0.6035	0.077 *	0.546	-0.7082	0.041 **	0.492
LAND_PCAP	-0.3639	0.164 ns	0.694	-0.2475	0.117 ns	0.780
LAND_PADULT	0.0267	0.847 ns	1.027	0.1349	0.038 **	1.144
INCOME_PCAP	0.0020	0.522 ns	1.002	0.0025	0.383 ns	1.002
N = 297						
Log likelihood	36.38					
Prob > Chi square	0.0139					
Pseudo R^2	0.0591					

* 0.1 significance level, **0.05 significance level, ***0.01 significance level, ns not significant

Table 24 compares the referent group of households that are members of a Smart Logistics group with non-members (both sellers and non-sellers). The coefficients are the multinomial logit estimates for a one-unit change in the independent variable, holding other variables in the model constant. Recall that the parameter estimates are interpreted in relation to the reference group of group members. A positive coefficient implies that a one-unit increase in the independent variable will *increase* the likelihood that the household will *remain in the non-member group*, while a negative coefficient indicates that a one-unit change will *reduce* the likelihood that the household will *remain in the non-member group*. To make the coefficients easier to interpret, we take the exponent of the log odds, or the odds ratio. Thus, an independent variable with an odds ratio of less than one means that a change in this variable increases the odds of being included in the reference group of members, while an odds ratio above one reduces the odds of being included in the reference group.

Panel 1 compares the reference group of households that are Smart Logistics members with households that are non-members but sell sorghum through a Smart Logistics group. Three of the independent variables (TOTSCHOOL, MAIZE_PURCHASE, and OCCUP) were statistically significant at the 0.05 level or above. The negative coefficients for TOTSCHOOL and OCCUP indicate that non-members that sell sorghum are less likely to remain non-members if they have more formal schooling and if they are full-time farmers. On the other hand, the coefficient for MAIZE_PURCHASE has a positive sign, indicating that households are less likely to become members if they make more maize purchases.

Panel 2 compares the reference group of households that are Smart Logistics members with households that are neither group members nor sell sorghum. Six of the 10 independent variables were statistically significant at the 10 % level or above. The coefficients for FHH_DEFACTO, HHAGE_SQ, TOTSCHOOL, and OCCUP displayed a negative sign indicating that a one-unit increase in these variables reduced the likelihood of being non-members and non-sellers. However, a one-unit increase in LAND_PADULT and MAIZE_PURCHASE increased the likelihood of not becoming a group member and of selling sorghum.

Table 25 provides further information on why households did not join Smart Logistics groups. Interestingly, the main reason was not because non-members failed to meet the selection criteria. Only 17 % of non-members reported that they did not produce enough sorghum to join, and only 1 % reported that the membership fee was too high. Instead, the most important reason (36 % of non-members) was the time required to attend group meetings. Similarly, of the 15 households that had formerly been members of a Smart Logistics group, the majority (73 %) reported their main reason for dropping out was the lack of time to attend meetings. Besides group meetings, members were also required to attend meetings at demonstration plots. Eighty percent of Smart Logistics groups in the sample had demonstration plots where group members were trained in sorghum production.

Table 25: Reasons given for not joining a Smart Logistics group (%)

Reason	Non-members		
	Sellers (n=73)	Non-sellers (n=71)	Total (n=144)
Do not have enough time to attend meetings	44	28	36
Do not produce enough sorghum to sell	10	25	17
No Smart Logistics group near enough	11	9	10
Do not have enough information on Smart Logistics group	6	13	9
No benefit from joining Smart Logistics group	12	3	8
Smart Logistics sorghum price is too low	7	9	8
Do not know a Smart Logistics group to join	2	6	4
Do not trust the group to pay me	1	4	3
Group allows only friends and relatives	3	1	2
Smart Logistics do not pay immediately	1	1	1
Cannot afford registration and membership fee	1	1	1
Smart Logistics is too strict on quality	1	0	1

Failure to attend group meetings or meetings at demonstration plots was punished by fines. These ranged from token payments of KES 20-30 in the case of the Kawongo Cereal Growers group up to KES 100 in the case of the Maliku Cereal Growers group (Table 26). Of the 150 members of Smart Logistics Groups in the sample, 65 members (43.3%) reported missing a group meeting and 46 (37.1%) had missed a demonstration plot meeting. Sixty percent of members had paid fines for missing meetings.

Demonstration plot meetings are held from 8 am to 4 pm once every week during the season. Members who miss the meeting pay a fine of KES 200, or KES 20 if they arrive late. Those who refuse to pay are given a grace period until harvest. Those who don't pay after harvest won't get their share of the harvest from the demonstration plot. It's common that people don't come but they pay the fines because they don't want to miss out on this harvest. If they can't come because of an emergency, they are not fined but given extra work to do. (Kanduti Self Help Group March 2013)

Table 26: Time required for meetings and penalties for non-attendance

Name of Cluster	Fees	Meetings	Fines
Maliku Cereal Growers (Katulani)	KES 100 registration fee	Once a month for 2 hours	KES 10-50 per day
Kanduti Farmers Field School	No registration fee, pay KES 10 each weekly meeting	Once a week for 5 hours	KES 100
Kawongo Cereal Growers	KES 700 registration fee, and members receive a goat	Once a month, for 2 hours.	KES 20 if 30 minutes late. KES 50 if longer

One reason non-members did not have time to attend meetings was that they were already members of other groups. Of the 147 non-members of Smart Logistics groups, 96 (65.3 %) belonged to other farmer groups (Table 27). Non-members that sold sorghum through a Smart Logistics group were less likely than non-member non-sellers to belong to another group. These households were 'free-riders' who used the group as a convenient way to sell their sorghum. However, households that reported 'lack of time' as a reason for not joining a Smart Logistics group were *not* those that were already members of other groups, but households that did not belong to *any* group. Evidently, the livelihood strategies of such households did not depend on collective action.

Table 27: Membership of other groups for non-members of Smart Logistics groups

Variable	Sellers (n=75)	Non-sellers (n=72)	Sig. Level (p<)
Non-members who are members of other groups (no.)	43 (57.3)	53 (73.6)	0.056**

**0.05 significance level

Among all groups, the most important activity was table-banking (*chama*). Members who chose to participate paid a deposit that was used as a rotating loan. Table banking was a central feature of Smart Logistics groups, with eight in 10 members participating (Table 28). Although non-sellers were more likely to be members of other groups, they were less likely to participate in table-banking.

Table 28: Participation in table-banking by all group members (%)

Variable	Members of Smart Logistics groups (n=150)	Non-members who are members of other groups		Sig. Level (p<)
		Sellers (n=43)	Non-sellers (n=53)	
Households participating in table banking (no.)	118 (78.6)	35 (81.4)	32 (60.4)	0.032**

**0.05 significance level

Members who want to participate in table banking must pay KES 2,100 (KES 2,000 for shares in the bank and KES 100 membership fee to the group). Members are allowed to borrow for one week, after which loan is repaid. The maximum loan is KES 5,000. Members usually borrow only when they expect to earn cash soon from some other source (for example, selling from a kiosk, or buying and selling poultry or goats). If they default, they pay back double. Most people will quit rather than risk defaulting, and lose trust. Alternatively, members can pay just KES 100 and join the group in order to sell sorghum. (Kanduti Farmers Field School, March 2013).

In sum, Smart Logistics groups were socially and economically inclusive. Households headed by women, with high dependency ratios, and with less land per adult family member were significantly more likely to be members. Similarly, membership was not significantly related to income per head, showing that membership was not confined to better-off households. However, the reasons why Smart Logistics groups were inclusive may be due to other factors besides sorghum:

1. The name 'Smart Logistics group' is a misnomer because 14 of the 15 sample groups were formed before 2009 (Table 1). On average, they pre-dated Smart Logistics by five years. Their main function was table-banking, which provided a form of forced savings and allowed members to access low-interest loans without collateral. Of the 150 households that belonged to a 'Smart Logistics group', 118 (79 %) participated in table-banking. Sorghum was simply an additional activity to their core business of generating loans to members. Households within 'Smart Logistics groups' were free to include or exclude themselves from the sorghum value chain. In the 2012 short rains, for example, only 47% of group members actually sold sorghum.
2. The main reason households gave for not joining a Smart Logistic group was shortage of time to attend meetings. Thus, many households deliberately chose not to join a Smart Logistics group. They excluded themselves, because they saw membership as a poor use of their time. Thus, it would be a mistake to view 'Smart Logistics groups' as exclusive clubs. The majority of sample households were

members of some group. Of the 297 households in the sample, 246 (83%) belonged to some type of group. This included 96 (66 %) of the 147 households that did not belong to Smart Logistics Groups. Rather than ask whether groups were ‘inclusive’, it is more appropriate to ask why 17 % of households excluded themselves and chose not to join.

3. Smart Logistics groups may be inclusive by accident rather than design. Most Smart Logistics groups were formed for other purposes. Hence, their inclusiveness may have less to do with sorghum than activities like table-banking. On the other hand, households that have not joined Smart Logistics groups have not been deliberately excluded. Rather, they have deliberately opted out, on the grounds that membership is too time-consuming. They have excluded themselves, because they see no benefits from group membership or from growing sorghum.

7. Conclusion

The value chain for sorghum beer in Kenya is inclusive, as defined by the standard socio-economic indicators. Not only is membership unrelated to income but households headed by women, with high dependency ratios, and with less land per adult family member are more likely to be members. This suggests that the benefits from commercialization of sorghum in Kenya are reaching poorer smallholders.

Average income from sorghum sales remains low, however (< KES 9,000 in 2012). Income per capita among group members averages KES 49,400. In terms of household income, therefore, income from sorghum is equivalent to about 18 % of average per capita income or just 3 % of total household income. Although at the margin this is important for poorer smallholders, it is not enough on its own to to lift a household above the poverty line. On the other hand, sorghum provides cash at a critical period before the payment of school fees in January. Consequently, sorghum is valued because it contributes to a major item of household expenditure. Moreover, investment in children's education offers a 'retirement package' for women, who have no legal rights to land or other household assets in the event of widowhood or divorce. From a gender perspective, therefore, sorghum makes a valuable contribution to economic security for women, by establishing a claim on their children's future income.

Less than 10 % of income from sorghum is invested in agriculture, casting doubt on the theory that linking farmers with markets for dryland cereals will result in a transition from subsistence to commercial agriculture. Eastern Kenya is a semi-arid environment where the returns from investment in agriculture are low and variable. This makes re-investment in agriculture a risky proposition. Income from sorghum is invested either in goats (viewed as insurance against drought) or in education that yields better or more secure returns than crop agriculture. In effect, income from sorghum is being used as a passport out of agriculture for the children of sorghum growers. The incentive for dryland farmers (especially women, who do not have legal rights to land) to invest in agriculture needs to be compared against the returns from these alternative investments.

Sorghum growers in eastern Kenya insist on growing maize although half reported that maize yielded poorly four years in five. At the same time, they agreed that sorghum gave a higher yield than maize in both a normal and in a drought year. Researchers have struggled to explain why farmers in such environments should continue to grow maize. The grower survey suggests two answers. One is a clearly expressed taste preference, by both adults and children, for maize over sorghum. The second is the recognition that 'maize is always there on the market'. Consequently, food deficit households have a strong incentive to plant maize because, when they run out of food, their only option is to buy maize. Whatever maize they grow for themselves reduces the amount of maize they will be forced to purchase. Farmers in eastern Kenya are therefore 'locked in' to the market for maize, partly by choice and partly from economic necessity (Brooks et al 2009).

While Smart Logistics has successfully developed an inclusive business model, it has been less successful in meeting the demand for sorghum from EABL. A decade after the introduction of sorghum beer, Smart Logistics is supplied by only 3,000 growers and Kenyan growers meet only one-third of EABL's total demand for sorghum. Experience with sorghum

beer shows that the reach of these models seems equally limited in Ghana (7,000 smallholders) and Zambia (4,600 smallholders) (Diageo plc, 2011). Herein may lie the weakness of inclusive business models. The more inclusive the model, the smaller the average quantity supplied by each grower, and the higher the transaction cost for the buyer. Reaching large numbers of growers on the scale required to meet demand requires significant investment in aggregation centres, training, as well as access to trade finance in order to buy the crop from farmers. The challenge for such models is to combine inclusion with the scale required to meet demand. Is this trade-off inherent in the nature of inclusive business models?

Finally, the future for sorghum beer in Kenya remains heavily dependent on political decisions. Sorghum beer can only compete with untaxed, illicit brews under a favorable tax regime. As in other developing countries, however, a large share of government revenue in Kenya is met from indirect taxation. This makes the tax break on sorghum beer a tempting target. Ultimately, Kenya's need for tax revenue has triumphed over the need to protect public health. Legislation and not cheaper beer is now the government's preferred option to protect consumers from illegal brews. How effective this will be remains to be seen. The story of sorghum beer in Kenya illustrates the important role played by policy makers in the development of a successful value chain, and the vulnerability of this same value chain to a subsequent change in policy. Success is never final.

References

Brooks, S., Thompson, J., Odame, Hannington, Kibaara, B., Nderitu, S., Karin, F., and Millstone, E. (2009). *Environmental Change and Maize Innovation in Kenya: Exploring Pathways In and Out of Maize*. STEPS Working Paper 36, Brighton: STEPS Centre.

Diageo Plc (2011). Generating prosperity through doing good business in Africa. www.**diageo**.com/Lists/.../1078/CSR%20Africa%20Report_web.pdf

East African Breweries Limited (2013). How an elephant learned to dance. The Senator Story. http://m.eabl.com/downloads/The-Senator-Story.pdf

GTZ (2007). *ValueLinks* Manual – The Methodology of Value Chain Promotion. http://www2.gtz.de/wbf/4tDx9kw63gma/ValueLinks_Manual.pdf

Kanter, R. M. and M. Bird (2009). Diageo and East African Breweries Ltd: Trading New Markets for Social Good. Case Centre Report 9-310-010. Mimeo, 23 pp.

Kenya National Bureau of Statistics, *Statistical Abstracts*, various years.

Mutisya, D. and Willis, J. (2009). Budget drinking: alcohol consumption in two Kenyan towns, *Journal of Eastern African Studies*, 3 (1): 55-73.

Ogola, F. G. O. and Mungai, E. (2011a). Corporate Social Innovation in East African Breweries Ltd (EABL): Senator Keg. Case Centre Report 711-020-1. Mimeo, 11 pp.

Ogola, F. G. O. and Mungai, E. (2011b). Corporate Social Innovation in East African Breweries Ltd (EABL): The Launch of Senator. Case Centre Report 711-008-1. Mimeo, 14 pp.

Van Wijk, J. and Kwakkenbos (2011). Beer multinationals supporting Africa's development? How partnerships include smallholders into sorghum-beer supply chains. In: Van Dijk, M. P. and Trienekens, J. (eds.), *Promoting Sustainable Value Chains: The Role of Governance*. (Amsterdam: Amsterdam University Press), pp. 71-88.

Willis, J. (2003). New Generation Drinking: The Uncertain Boundaries of Criminal Enterprise in Modern Kenya, *African Affairs*, 102: 241-260.

Appendices

Appendix 1. Macro-economic data for beer, Kenya, 1963-2011

Variable	Beer production	Beer consumption	Adult population	Beer price	Maize price	Real price beer	Beer excise	Total excise
Units	000 litres	000 litres	No.	Ks/bottle	Ks/kg	Beer/maize	mill Ks	Mill Ks
1960	23044	18484	4118695	1.78	0.66	2.70	1284	
1961	39572	20643	4288808	1.81	0.66	2.74	1431	3860
1962	39586	20970	4458922	1.97	0.66	2.98	1697	5440
1963	44009	23821	4629035	2.03	0.59	3.44	2154	6020
1964	48455	23657	4799149	2.03	0.59	3.44	2155	6215
1965	49460	29749	4969262	2.16	0.88	2.45	2479	6384
1966	50088	31542	5139376	2.18	0.88	2.48	3044	7624
1967	48839	34026	5309489	2.3	0.88	2.61	3343	9590
1968	60001	41714	5479603	2.3	0.66	3.48	4291	11919
1969	64757	46210	5649400	2.4	0.55	4.36	4334	12914
1970	79533	77105	5873216	2.4	0.55	4.36	5838	15596
1971	93537	91974	6097032	2.3	0.55	4.18	6981	17160
1972	104825	102059	6320848	2.35	0.59	3.98	7647	17664

1973	139393	125848	6544664	2.35	0.6	3.92	9793	21632
1974	157634	153320	6768480	2.6	0.75	3.47	11116	24632
1975	153812	153260	6992295	3	1	3.00	10649	24894
1976	165807	161340	7216111	3.1	1.18	2.63	24143	28623
1977	195160	193550	7439927	3.3	1.28	2.58	14319	37803
1978	204986	192635	7663743	3.68	1.27	2.90	15617	44741
1979	212712	211283	7887559	4.08	1.25	3.26	15284	53614
1980	132424	232685	8214774	4.4	2.69	1.64	17033	60257
1981	248264	240425	8541990	4.79	4.17	1.15	18140	64672
1982	233736	240945	8869205	6	4.1	1.46	17555	68380
1983	217462	217017	9196420	6.88	4.19	1.64	15220	80558
1984	230345	229994	9523636	7.43	4.91	1.51	16387	78297
1985	263308	259643	9850851	7.7	6.21	1.24	17881	87505
1986	301637	255235	10178066	8.06	6.5	1.24	20180	95782
1987	307500	307592	10505281	8.55	6.5	1.32	21710	113930
1988	314382	314456	10832497	9.43	6.5	1.45	21398	129757
1989	315402	314169	11159712	10.68	6.5	1.64	23819	144295

1990	331114	325194	11639689	12.14	6.5	1.87	20686	151965
1991	314005	308474	12119666	12.46	6.5	1.92	53326	170588
1992	368648	362728	12599644	13.3	6.29	2.11	190367	365070
1993	349200	340199	13079621	14.42	8.54	1.69	251321	442103
1994	325005	351464	13559598	33.25	17.4	1.91	284696	486178
1995	347000	300788	14039575	36.17	12.58	2.88	6538.9	11846.56
1996	283208	246957	14519552	41	13.67	3.00	7172	12831.32
1997	270396	247740	14999530	43.67	19.34	2.26	7452.02	13321.7
1998	263015	256555	15479507	49.5	16.7	2.96	7927.1	13831.9
1999	188455	188429	15959484	51.25	19.79	2.59	7043.21	13278.85
2000	202932	208187	16561249	50.14	20.54	2.44	7487.5	13605.43
2001	184300	199505	17163014	53.96	15.59	3.46	7307.21	12446.18
2002	191925	193937	17764779	55	15.44	3.56	7779.65	12925.05
2003	222293	207518	18366544	60	17.96	3.34	7907.96	13445.49
2004	237548	268067	18968309	60	20.51	2.93	8350.8	14842.55
2005	266261	265541	19570074	62.6	20.44	3.06	9325.11	16233.75
2006	311557	297325	20171839	66.41	20.9	3.18	10021.94	17121.72

2007	393422	350937	20773604	69.71	19.04	3.66	11266.54	19696.79
2008	424863	381059	21375369	78.47	26.45	2.97	11091.33	22097.21
2009	396819	340230	21977134	90.24	27.53	3.28	13756.56	23733.33
2010	398618	358353	22578899	97.87	25.05	3.91	14701.54	26429.08
2011	453685	412288	23180664	110.16	37.92	2.91	14456.04	27661.89

Sources: Statistical Abstracts, various years. Adult population (15 +) from Census, 2009, 1999, 1989, 1979, 1969, 1962.