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TRADE AND AGRICULTURAL COMPETITIVENESS FOR GROWTH, FOOD SECURITY AND POVERTY REDUCTION: A CASE OF WHEAT AND RICE PRODUCTION IN KENYA

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Tegemeo Institute of Agricultural Policy and Development

P.O Box 20498, 00200, Nairobi, Kenya

Tel: +254 20 2717818/76; Fax: +254 20 2717819

E-mail: egerton@tegemeo.org

Tegemeo Institute

Tegemeo Institute of Agricultural Policy and Development is a Policy Research Institute under Egerton University with a mandate to undertake empirical research and analysis on contemporary economic and agricultural policy issues in Kenya. The institute is widely recognized as a centre of excellence in policy analysis on the topical agricultural issues of the day, and in its wide dissemination of findings to government and other key stakeholders with a view to influencing policy direction and the decision making process. Tegemeo's empirically based analytical work, and its objective stance in reporting and disseminating findings has over the past decade won the acceptance of government, the private sector, civil society, academia, and others interested in the performance of Kenya's agricultural sector.

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Kindaruma Lane, off Ngong Road

P.O. Box 20498, 00200, Nairobi, Kenya

Tel: +254 20 2717818/76; Fax: +254 20 2717819

E-mail: egerton@tegemeo.org

URL: http://www.tegemeo.org

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Abstract

Currently, Kenyan farmers produce a minority share of the national wheat and rice consumption needs. As shown by the dramatic increase in the import bill between 2003 and 2008, reliance on the international market has implications for food security, especially given a volatile world market. This study examines the competitiveness of the wheat and rice sub-sectors in Kenya. Overviews of wheat and rice value chains are presented, followed by estimates of costs and profit margins along each node of the value chain based on interviews with farmers, traders, transporters and millers.

Using farm data, a stochastic frontier model is applied and wheat producers are classified according to technical efficiency scores. At a price of US$ 220 per ton and with an import duty of 10%, only efficient and average wheat producers are competitive. Small-scale farmers (<20 acres) demonstrate high levels of technical efficiencies. Production inefficiencies arise from high input costs (fertilizers, chemicals and seeds), high costs of machinery operation, high maintenance costs and low yields. Inefficiencies encountered by transporters include high maintenance costs, high fuel prices, poor infrastructure (especially feeder roads connecting production areas and the markets) and road blocks. Wheat traders also face multiple layers of taxation imposed by local authorities, especially when grain crossed several municipalities.

Rice farmers were classified using the Mwea Irrigation Agricultural Development (MIAD) input use guide. At a price of US$ 440 per ton of imported milled rice and using a 35% import duty, only average and high input users remain competitive. If imported rice were duty free, only high input users would be competitive. At an import duty rate of 75%, all three farmer categories would compete favorably. Inefficiencies along the rice value chain include high labor costs, high rates of rural-urban migration, and water borne disease. Costs of fertilizer, chemicals and seeds are high, while yields were low. Changing weather patterns have reduced the amount of water flowing to the schemes. Among transporters, traders and millers, major constraints were high cost of electricity and labor, fuel and maintenance costs, and the poor state of the roads.

We propose policies to enhance Kenya's competitiveness in wheat and rice production. With respect to wheat, these include duty waiver on agricultural machineries and spare parts, harmonization of taxation, bulk purchase and importation of inputs, and streamlining of procedures for importing and releasing fuel from Mombasa, as well as continued investments in wheat research and development, and in promoting the use of more recently released modern varieties. For rice, recommendations include eradication of water borne diseases in the schemes to ensure labor availability, adoption of simple technology from Asia that can be used in paddy rice production, rehabilitation of the current rice schemes to ensure efficiency in water distribution, and investments in research and development, cheaper sources of energy and irrigation, as well as processing, branding and marketing activities in the rural rice-growing areas.

Key words: competitiveness, value chain, inefficiency, wheat, rice

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Acronyms

AGMARK	Agricultural Marketing Development Trust
AGOA	African Growth Opportunity Act
AGRA	Alliance for a Green Revolution in Africa
AIDS	Acquired Immune Deficiency Syndrome
ASDS	Agricultural Sector Development Strategy
C&F	Cost and Freight
CAFTA-DR	Dominican Republic-Central America-United States Free Trade Agreement
CARD	Coalition for African *Rice* Development
CEUCA	Customs and Economic Union of Central Africa
CGA	Cereal Grower Association
CIF	Cost, Insurance, and Freight
CMA	Cereal Miller Association
CMA	Common Monetary Area
CNFA	Citizens Network for Foreign Affairs
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EAGC	Eastern Africa Grain Council
ECOWAS	Economic Community of West African States
ERS	Economic Research Service
ESA	Endangered Species Act
EU	European Union
FAO	Food and Agriculture Organization
FOB	Free on Board
GDP	Gross Domestic Product
HIV	Human Immunodeficiency Virus
IDF	Import Declaration Fee
IFPRI	International Food Policy Research Institute
IGC	International Grain Council
IRRI	International Rice Research Institute
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Services
KPA	Kenya Ports Authority
LBDA	Lake Basin Development Authority.
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries
MDG	Millennium Development Goals
MIAD	Mwea Irrigation and Agricultural Development
MT	Metric Tons
MOA	Ministry of Agriculture.

NACCRI	National Crops Resources Research Institute
NARO	National Agricultural Research Organization
NBER	National Bureau Of Economic Research
NCPB	National Cereal and Produce Board
NERICA	New Rice for Africa.
NIB	National Irrigation Board.
NRDS	National Rice Development Strategy.
NTB	Non-Tariff Barrier
OPEC	Organization of Petroleum Exporting Countries
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernization of Agriculture
PRSP	Poverty Reduction Strategy Papers
PTA	Preferential Trade Area for Eastern and Southern African States
RTA	Regional Trade Agreement
SACCO	Savings and Credit Cooperative.
SACU	Southern African Customs Union
SADC	Southern Africa Development Community
SGR	Strategic Grain ReserveSRA Strategy for Revitalising Agriculture
TAPRA	Tegemeo Agricultural Policy Research and Analysis
TICAD	Tokyo International Conference on Africa Development
TRQ	Tariff Quota
UDEAC	Union Douaniere et Economique de l'Afrique Centrale
UNRDS	Uganda National Rice Development Strategy.
USDA	United States Department of Agriculture
UURGA	Uganda Upland Rice Growers Association
VOC	Vehicle Operating Cost.
WARDA	West African Rice Development Association
WTO	World Trade Organization.

1.0 Introduction

1.1 Background

The lack of competitiveness of Kenya's production systems compared to those of her trading partners remains unresolved. Kenya has over the years maintained a structural deficit in the major grains and food staples, namely maize, wheat and rice. This deficit has often been met through imports from EAC, COMESA and/or the world market. According to the Ministry of Agriculture, wheat and rice are the second and third most important cereals after maize. Despite this, Kenya produces only about 40% and 20% of its national requirements for wheat and rice, respectively (Economic Review of Agriculture, 2010; National Irrigation Board, 2008). Lack of competitiveness in the domestic wheat production compelled Kenya to request safeguard measures in accordance with the COMESA treaty provisions[1]. However, the expiry of the safeguards in December 2009 does pose critical questions regarding the survival of Kenya's domestic wheat industry.

Analysis of FAO data shows that there has been an increase in the per capita consumption of wheat in Kenya. The three year average per capita increased from 25 to 27 Kgs/year during 2003-2005 and 2006-2008 periods. The percentage growth rate of per capita consumption in Kenya was negative between 1980 and 1994 (-0.3%), but rose to 1.2% between 1995 and 2008 (Aquino and Carrión 2009). The growing dominance of wheat in consumption in many cities of East and Southern Africa is attributed to urbanization, growing preference for wheat products as convenience foods and a decline in the price of wheat relative to maize (Jayne, et al. 2010). According to Muyanga, et al. (2005), wheat and its by-products in 2003 accounted for 44% of total expenditure of main staple in urban areas in Kenya, up from 35% in 1995. Kamau, et al. (2010), indicates a slight decline between 2003 and 2009 in the share of wheat and its by-products (from 43% to 40%) in total expenditures of urban households. They suggest that the decline was caused by high food prices during the 2007/08 period.

[1] The safeguard is by way of a Tariff Quota (TRQ) that limits imports of wheat and wheat products under COMESA preferences. Imports in excess of the set quotas are liable to a duty as determined by the Kenyan Government.

According to the National Irrigation Board (NIB), the annual consumption of rice has increased at a rate of 12%, which is also attributed to progressive changes in eating habits by urban dwellers. Muyanga et al. (2005) indicates that rice constituted 20% of the total expenditure on main staples in 2003. This same proportion was estimated at 20% in 2003 and 23% in 2009 (Kamau et al. 2010). NIB estimates the current per capita consumption of rice at 7 kgs/year and projects that this will increase to 15 kgs/year in 2015. The food crisis that plagued the country in early 2007 is a clear of indication of the need to bolster production of not only maize but also wheat and rice, and to diversity to other cereals, such as sorghum and millet, to guard against the price volatility in the world market.

Wheat and rice can play a major role in ensuring food security, given the country's reliance on maize. The wheat sub-sector contributes 1.4% and 30% to overall and cereal GDP respectively (Barasa, 2004), employing over 500,000 people through linkages with several sectors such as transport, storage and distribution. The wheat industry contributes over Ksh.20 billion and supports about 11.3 % of the national population (Economic Review, 2009, Barasa, 2004). Kenya also has potential in rice production. Rice is grown by about 300,000 farmers, who provide labor and also earn their livelihood from its production. The area under rice production in Kenya has marginally increased from 1960s while production maintained a steady increase up to 1973 before becoming quite erratic (FAOSTAT). The country has a potential of about 540,000 hectares of irrigable land and 1.0 million hectare of rain fed land suitable for rice production. With improved water harvesting, storage, underground water resource utilization and innovative management technologies, the current irrigation potential can be increased by a further 800,000 ha to 1.3 million hectare (MOA, 2010).

Tegemeo Institute conducted this study to better understand challenges facing the production and marketing of these two cereals. The broad objective was to assess the competitiveness of Kenya's wheat and rice production systems with a view to establishing why the country continues to be a high cost producer of these two commodities. The specific objectives included i) establishing the cost of production of wheat and rice at the farm level, ii) estimating costs and margins along the value chain, iii) identifying inefficiencies along the value chain, and iv), exploring policy options to address these inefficiencies.

The paper is organized into four sections. Section one presents the introduction, methodology and conceptual framework employed. Section two presents an overview of the wheat and rice value chains in Kenya, in the context of global wheat and rice production and trade. Section three presents the main findings of the study. Conclusions and policy options are presented in the final section.

1.2 Methodology and Conceptual Framework

A value chain approach was used to identify actors, policies and institutions, assess costs and establish challenges and inefficiencies. According to Vermeulen et al. (2008), a value chain includes all the activities that are undertaken in transforming a raw material into a product that is either sold or consumed. These include the direct function of primary production, collection, processing, wholesaling and retailing, as well as support functions such as input supply, financial services, transport, packaging and advertisement. On the other hand, value chain analysis involves sequencing the productive processes of a product/commodity. The extended value chain approach is increasingly being used to understand global agricultural commodity markets and is also gaining popularity in domestic markets. The extended value chain approach considers all the intermediaries involved along the chain (Humphrey, 2005). This approach is often considered to be more accurate in reflecting real processes and complexity involved in the interdependencies among the chain actors. The extended value chain approach is used in this study. The methodology involves i) mapping the value chain to identify the main actors, intermediaries and the flow of the commodity; ii) mapping key policies and institutions along the value chain that influence the functioning of the value chain; and iii) establishing key drivers, trends and issues affecting the value chain and it actors.

For this paper, the methodology used include estimation of the cost of production for wheat and rice, and the computation of technical efficiency scores especially for wheat farmers following the Kopp and Diewert (1982) cost decomposition procedure. We also established the costs and margins along the wheat and rice value chains. In addition, using the landed costs of imported wheat and rice, we simulated scenarios with and without import tariffs to evaluate competitiveness of locally produced wheat and rice compared to imports.

1.3 Data

This study uses both primary and secondary sources of information. Primary data was collected along the wheat and rice value chain and is summarized on Table 1.1. Key informant interviews were carried out with various players in the wheat and rice sub-sector. Areas producing wheat and rice were purposively selected.

For wheat, these areas included Nakuru, Narok and Uasin Gishu. To select farmers, the research team visited the Ministry of Agriculture staff in the respective districts. With the help of Ministry staff at the district the research team established the division within the district that wheat was predominantly grown by farmers. The team purposively picked two divisions from each district where wheat was predominately grown. The team visited the respective divisions. At the divisional level the Ministry staff provided the research team with the list of households and acreage of the farms within the division. This list from the Ministry staff formed the sampling frame. The sampling procedure used was stratified proportional sampling method since the population of wheat farmers was not homogenous. The team divided the farmers into small (less than 7 acres) medium (7 to 20 acres) and large (over 20 acres). Small scale farmers were sampled from Nakuru while medium and large scale farmers were sampled from Narok and Uasin Gishu. From each of the category farmers were randomly selected.

With regards to rice, the areas purposively selected were Mwea and Ahero schemes in Kirinyaga and Nyando districts respectively. The research team visited the two schemes. In each scheme the NIB field office had a list of all the farmers within the scheme. From these lists of farmers the team randomly selected farmers to interview. Traders along the distribution channel were classified into small and large scale traders for the purposes of this study. The criteria used were mode of transportation and the volumes of grain handled per month. Small scale traders used pick-ups as the mode of transport and handled less than 200 bags per month, while large scale traders handled over 2000 bags per month and used 10 metric ton lorries. From each category the team purposively picked traders to interview. Transporters especially for wheat were found outside the wheat mills in Nakuru, Narok and Eldoret town. The research team purposively picked transporter who were either owners or understood the operation of the business to interview. The challenge faced by the team especially in conducting interviews with traders and transporter was mainly getting the owners/employee who understood all the operations of the business.

On milling, wheat millers were categorized into small, medium and large scale according to equipment and milling installed capacity. The small miller consisted of hammer mills with a milling capacity of about 2.7 tons per day. Both[2] the medium and large scale wheat millers did not provide information on their milling cost breakdown. Rice millers were also classified into two (small and medium) based on equipment and milling capacity. Small scale millers had at least a simple mill, weighing scale and a drying yard. A medium scale miller has at least rice milling chain or compound rice mill, drying yard, pre-cleaner, husker, destoner, grader, bucket elevators, a weighing scale, and a packaging unit. In Mwea scheme, two medium scale millers were interviewed and they had an average milling capacity of 2,235 tons of paddy rice (1,341 tons milled rice) per month while in Ahero one medium scale miller was interviewed. The milling capacity was 203 tons of paddy rice (121 tons of milled rice) per month. Two small scale millers were interviewed in Mwea and one in Ahero.

Table 1.1: Number of respondents interviewed

	Wheat	**Rice**	
Category Interviewed	**Kenya**	**Kenya**	**Uganda**
Farmers	201	40	20
Traders/transporter	16	20	10
Millers	2	6	5

*In the wheat value chain most of the traders also doubled as transporters
*In the rice value chain most millers were situated close to the farm. Unlike in wheat, rice milling constitutes a simple process of removing the husks.

[2] According to Cereal Millers Association (CMA) there are 23 large scale millers and about 100 medium scale millers across the country. On average they mill 770,000 metric tons of wheat per year; this comprises 270,000 metric tons of local and 500,000 metric ton of imported wheat. The installed milling capacity for large scale millers is estimated at 3,600 metric tons of wheat per day while medium scale millers capacity is about 100-200 metric tons per day

2.0 Overview of Wheat and Rice

This section is divided into two parts. In the first part, we report world trends in wheat production and trade. We focus particularly on wheat production and exports in Egypt and Mauritius because these two countries are important wheat exporters to the COMESA region. The wheat sector and value chain in Kenya are described. In the second part, world trends in rice production and trade are presented, highlighting Pakistan, which is the major exporter of rice to Kenya. The case of NERICA rice in Uganda is briefly highlighted. There is great potential in Kenya in increasing area under rice production through upland rice. The Uganda government has successfully increased rice production in the past 7 years especially through the promotion of upland rice resulting in upland rice being grown on a wider scale. Currently area under upland rice production in Uganda constitutes 71% of total area under rice production. The case of NERICA production in Uganda would provide learning lessons that may be replicated and up scaled in Kenya.The value chains for wheat and rice in Kenya are then discussed.

2.1 Wheat

2.1.1. Global and Regional Scenario

According to the Agriculture Outlook of FAOSTAT in 2008, both wheat production and demand has been increasing over time. During the close of season in 2008, the world wheat stocks were 109.7 million tons. This is the lowest opening stock for wheat recorded since 1982. The increase in demand for wheat resulted in an unprecedented rise in the price of wheat. The average export price of hard winter wheat increased by 56% (from US $ 212 per ton to US $ 331) between 2006 and 2007 while that of soft red wheat increased by 72 % (from US$ 176 to US $ 303 per ton). Time series data from FAO shows a steady increase in wheat production and yield, with a constant trend in area under production. Wheat imports more than doubled between 1961 and 2009 (increased from under 50 million tons to over 100 million tons respectively).Trend analysis shows that production, yields, imports and area increased by 208%, 179%, 220% and 10% respectively between 1961 and 2009 (Figure 2.1).

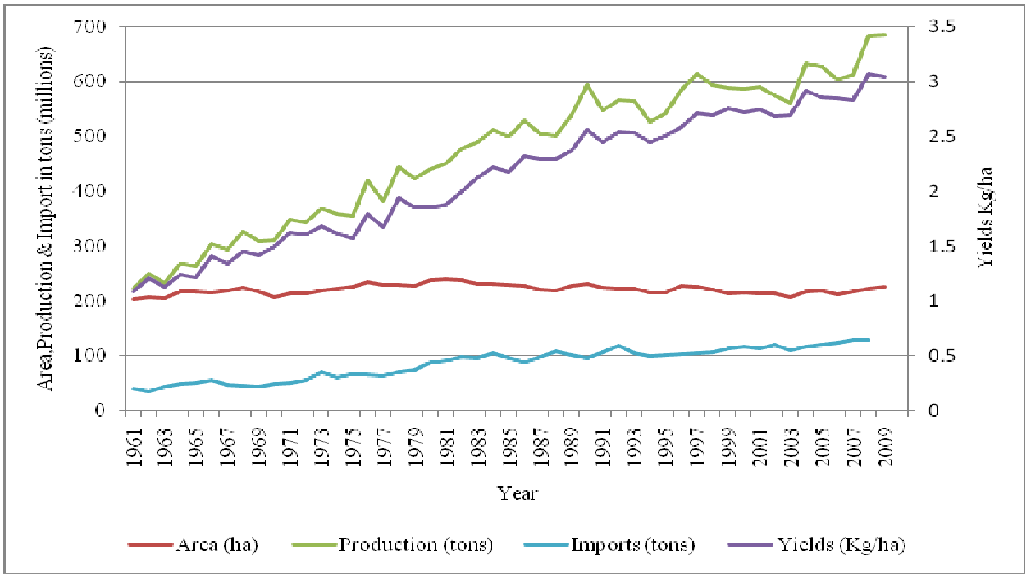

Figure 2.1: Global area under wheat, production and yields
Source: FAOSTAT

The top ten wheat producing countries and their share of global world production is summarized in Figure 2.2. These top ten countries account for two-thirds of the world's wheat production. China leads the group followed by India and the USA in that order. Although China and India are the leading producers of wheat, they also import wheat as the country's production cannot meet the demand due to their large populations and the importance of the crop in the diet. China's annual consumption of wheat averages 112,501 MT against an average production of 108,712 MT while India's annual consumption averages 65,282 MT against at an annual production of 65,856 MT.

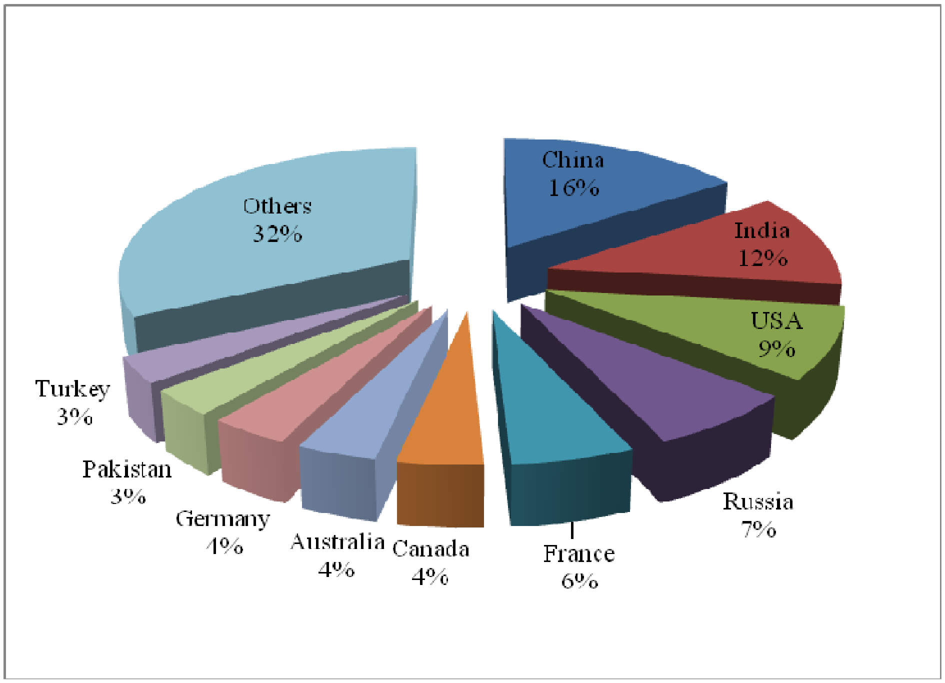

Figure 2.2: The share of top ten wheat producers in the world (2002-2008)
Sources: USDA, 2010; International Grain Council, 2010; author compilations

The USA is the leading wheat exporter in the world followed by Canada and Australia in that order. Between 2002 and 2008, these three countries (USA, Canada and Australia) exported an annual average of 27.1, 14.4 and 15.2 million MT, respectively (USDA, 2008). Figure 2.3 summarizes the average shares of world's total wheat exports by leading exporter from 2002 and 2008.

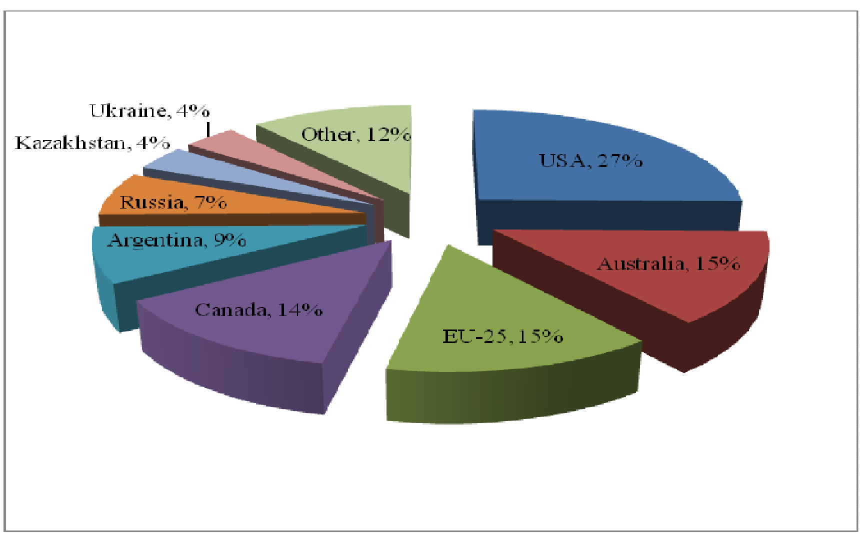

Figure 2.3: Top exporter average shares of annual global exports (2002-2008)
Sources: USDA, 2010; International Grain Council, 2010; author's compilation

In Africa, Egypt and Mauritius are dominant with regards to export of milled wheat to the COMESA region. Given that wheat safe guard for Kenya expired in 2009 it is critical to look at these two countries to understand what measures the Egyptian and Mauritius governments has undertaken to ensure their dominance in milled wheat exports to the COMESA region.

Egypt is among the largest wheat importer in the world, the country also has the highest per capita consumption of wheat in the world (180 Kgs). Wheat is a key staple food crop, occupying 33% of total winter crop area, accounts for 9% of water resource and contributes to 17% of total value added in Egyptian agriculture. It also provides 34% of total daily protein consumption and one-third of daily calories intake (Siam and Andre,2007).

According to the International Food Policy Research Institute (IFPRI, 1990), crop production and yields have recorded a significant growth in Egypt after the sub-sector was liberalized in 1987. The country however remains a net importer of wheat. This is because the area allocated to wheat production in the Nile valley and the delta is not adequate to produce for its populations given that 90% of Egypt is a desert. Thus irrigation plays an important role in the country's agriculture. Out of the 3.3 million hectares of arable land, a quarter has been reclaimed from the desert. The reclaimed land generates about 7% of the total value of agricultural production (Guven and Ibrahim, 2009).

During the cropping seasons in 2005/06 and 2008/09, the country produced an average of 8.1 million MT of wheat while consumption during the same period was 15.6 million MT. The annual costs of wheat imports were US$ 1.2 billion (USDA, 2009). Nonetheless, local production of wheat is still strategic to the Egyptian government. To encourage local wheat production, the Egyptian government has undertaken several measures which include: provision of moderate subsidies on agricultural production that are below the level allowed by the World Trade Organization (WTO); price control on wheat; payment of high prices to local producers; and encouraging expansion of area under wheat and the growing of high yielding variety by the local producers[3]. Government efforts to increase local wheat production have been successful as

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[3] Locally produced wheat is mainly used for home consumption, stored as seed and also exported to other countries while imported wheat is used to make the highly subsided bread for low income consumers

evidence by the increase in both acreage and production of 11% and 24%, respectively between 2002 and 2007. The average yield per hectare was 6 ton over the same period (Table 2.1).

Table 2.1: Wheat production trends in Egypt

YEAR	Area (ha) '000	Yield (MT/ha)	Production (MT) '000
2002	1030	6.4	6,564
2003	1053	5.9	6,254
2004	1095	6.4	6,624
2005	1254	5.5	6,844
2006	1287	5.6	7,177
2007	1139	7.1	8,140

Source; FAOSTAT and USDA, 2009

Although Egypt is a net importer of wheat, it is a major exporter of milled wheat in the COMESA region. Egypt is able to benefit from the Regional Trade Agreements (RTA) between the COMESA states that is discussed on the Rule of Origin[4]. The quantity of milled wheat imported from Egypt to COMESA region between 2003 and 2007 increased from 179 tons to 7,153 tons (FAOSTAT, 2008).

Mauritius is another country that exports wheat into the COMESA region. The case of Mauritius is unique in that it is not currently producing any wheat though it exports. The country imports its wheat mainly from France and Australia and mills then exports milled fortified wheat and wheat by- products to the COMESA region. Between 2000 and 2008, wheat imports increased by 15%, while consumption increased by 22%. The country's exports to COMESA and SADC region of fortified wheat and wheat by-products averaged 100,000 tons per year between the same periods (Table 2.2). On the other hand, wheat is among the main staple foods for the population with a per capita wheat consumption of 74 Kgs. Currently the Ministry of Agriculture has introduced two wheat varieties (HD 2189 and CC 464) from India on a trial basis and preliminary results indicate that these varieties have a potential of yielding 4 tons per hectare (Antoine, 2009).

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[4] Under this rule, goods eligible for duty-free treatment are those that meet the following requirements; goods are wholly produced or obtained in a member State; imported materials used in the production of the final good and does not exceed 60% of the total cost of all the material used in their production; a minimum of 35-40% domestic value added of the ex-factory cost of goods is achieved; if goods produced in member states are classified after the manufacturing process under a tariff heading other than the one under which they were imported; and a minimum of 25% domestic value added of the ex-factory cost of goods is achieved for goods of particular importance to the economic development of the member states

Table 2.2: Wheat demand trends in Mauritius

Year	Imports (MT) '000	Consumption (MT) '000	Exports (MT) '000
2000	305	205	100
2001	219	119	100
2002	260	160	100
2003	255	155	100
2004	244	144	100
2005	199	99	100
2006	262	162	100
2007	429	329	100
2008	350	250	100

Source: USDA,2009

2.1.2 Wheat Production in Kenya

The country produces an average of about 300,000 metric tons annually. Medium and large scale producers' account for 75% of total wheat produced. The national average yield stands at 10 bags per acre or 2 tons per hectare (Table 2.3).

Table 2.3: Structure of wheat farming in Kenya

Scale of operation	Yield (bags/acre)	Metric tons	% of total production
Small scale	6	75,000	25
Medium scale	9	90,000	30
Large scale	16	135,000	45
Total National	**10**	**300,000**	**100**

Source: Nyoro and Muyanga (2005)

As discussed earlier wheat and its by-products have gained importance in household consumption patterns in the last decade especially in the urban areas of Kenya. Kenya requested COMESA for a wheat safeguard so that it could address the lack of competitiveness and other challenges facing the sub-sector. The country was granted a safeguard up to May 30th 2005 which was extended to December of 2009. Under the safeguard regime, imported wheat attracted 35% import duty while white flour attracted 65%. With the lapse in these safeguards and in consistency with the EAC agreement, the Ministry of Finance announced a reduction of duty on imported wheat from 35% to 10% during the 2010/11 budget speech.

The country is currently producing about 40% of its total requirements and the deficit is met through imports (Nyoro and Muyanga, 2005; Economic Review of Agriculture, 2010). Figure 2.4 provides trends in the area under wheat, production, yields and imports in Kenya since 1961. The trends show that the area under wheat production has remained fairly constant; yields and production have been gently increasing (7% and 18% respectively) while imports have had a steady increase (53%) since 1981. The country experience drought during the period 2008/2009 and this may explain the sharp decline in both production and yields.

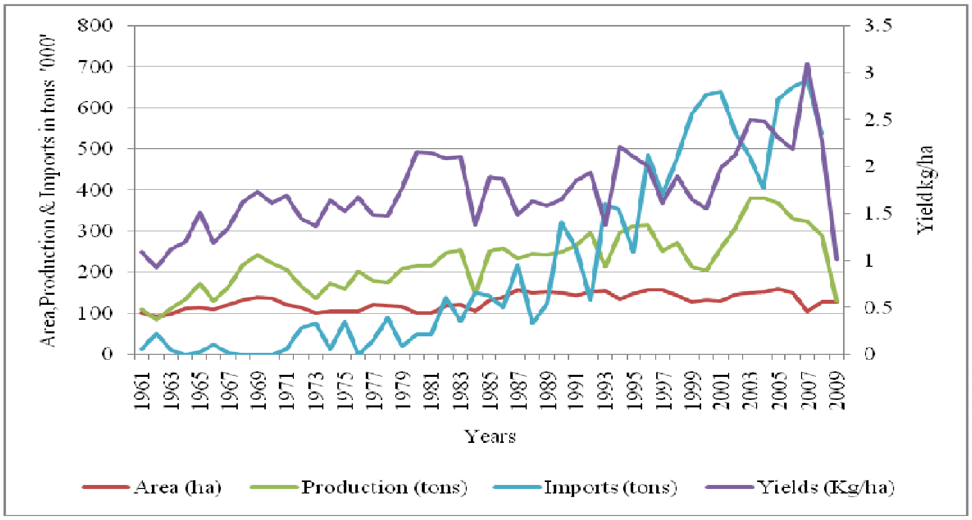

Figure 2.4: Trends in hectarage, yields, production and import of wheat in Kenya
Source: FAOSTAT

Kenya's imports increased by 55% between 2003 and 2009 (Statistical Abstract, 2010). Kenya has been importing most of its wheat from Argentina, USA, Ukraine, and Russia. The proportions of wheat imports from the main countries have differed over the years. Figure 2.5 summarizes the proportions of imported wheat by countries between 2004 and 2007. From the figure, Argentina was the main source of imported wheat in 2004 and 2005. From 2005, Russia and Ukraine emerged as important sources of imported wheat with the proportion from Russia increasing over time. Imports from the US remained fairly constant though increased slightly from 2006.

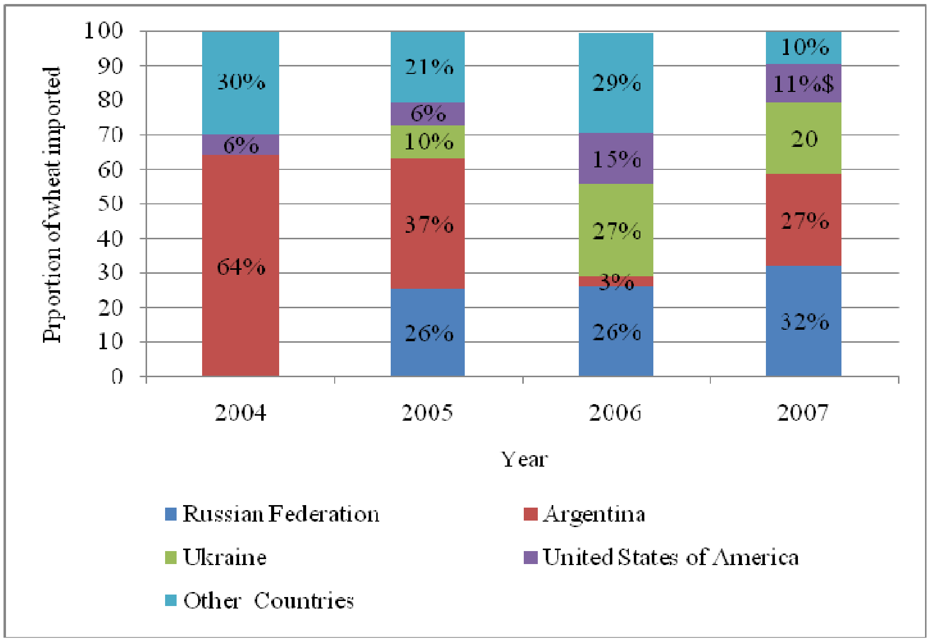

Figure 2.5: Proportion of total wheat imports to Kenya by country of origin
Sources: FAOSTAT, 2008;author compilations

Russia imposed an export ban from August 15 to December 31, 2010 .With the current export ban in Russia, Kenya will have to increase share of imported wheat from Argentina, Ukraine, USA and from other countries[5] so as to meet its consumption requirements. This will have an implication on Kenya's import bill. The country's expenditure on imported wheat has increased by 132% between 2003 and 2008 (Statistical Abstract, 2010). With the export ban in Russia and the increase in the world prices this will further exacerbate the situation locally.

2.1.2 The Wheat Value Chain in Kenya

Wheat production in Kenya is carried out by small, medium and large scale farmers. The definition differs accordingly. The Cereal Growers Association (CGA) defines large-scale farmers as farmers owning all their farm machinery and implements and cultivating 100 or more of wheat. Medium scale farmers may own some machinery and cultivate from 20 to 100 acres, and small scale farmers as cultivating less than 20 acres and mainly hire machinery.

[5] Others countries include Iran, Romania, Canada, Uruguay, United Kingdom, Ethiopia, Tanzania, Antigua, Barbuda, Australia, Brazil, Bulgaria, Czech Republic, Egypt, France, German., Japan, Italy, Kazakhstan, Lithuania, Netherlands, Pakistan, Singapore, Slovakia, Swaziland, Uganda, UAE

The value chain for wheat in Kenya is summarized in Figure 2.6. Wheat grain production and distribution involves a number of actors. Major actors are; input suppliers, farmers, transporters, small & large scale traders, institutions, small, medium and large scale millers and consumers (individuals, institutions). Main inputs for the industry comprised of seed, fertilizer and chemicals which are distributed to farmers through various institutions. On seed there were various players in the industry. All the high yielding varieties in the country has been developed by KARI in collaboration with other partners such as CIMMYT. The earliest releases recorded in CIMMYT's databases were improved tall varieties in 1966, but all varieties grown in Kenya today are improved, semi dwarf wheat (Lantican, Dubin and Morris 2005). Between 1985 and 2008, KARI released 21 wheat varieties that address pest and disease challenges faced by Kenyan farmers (KARI 2008).

The distribution of the seeds and other inputs such as fertilizer and chemicals to the farmers is done through input suppliers (agro-dealers) that are spread out in most towns and shopping centers in the rural areas. According to the Ministry of agriculture and CNFA/AGMARK, there are an estimated 5,600 agro-dealers distributed across the country and about 9,000 wheat farmers distributed in Narok, Nakuru, Timau and Uasin Gishu districts. There are traders, transporter and miller that are also players along the value chain. Traders are in two categories small and large scale traders. The small scale traders' were using pick up as mode of transportation and handle about 200 bags per month while large scale traders used 10 MT Lorries and handle over 2000 bags per month. There were small, medium and large scale millers in the wheat value chain. The small scale millers used simple machinery and were located in trading centers especially in Nakuru. According to CGA there are 100 medium scale millers and 23 large scale millers in Kenya. The installed capacity of the medium scale millers is between 100-200 MT per day, while for the large scale millers installed capacity is 3,600 MT per day. Both medium and large scale millers are situated in the major town (Eldoret, Nakuru and Narok). From the millers, the milled wheat either goes to the bakeries which produce wheat by- products such as cakes, bread, and biscuits, amongst others. The milled wheat is also distributed through supermarkets or wholesalers who then sell directly to consumers. Transport services cuts across the whole value chain. For this study we interviewed the transporters who deliver wheat grain to the millers.

They owned 10 MT lorries and handled about 250 bags per trip. Figure 2.6 summarize the wheat value chain.

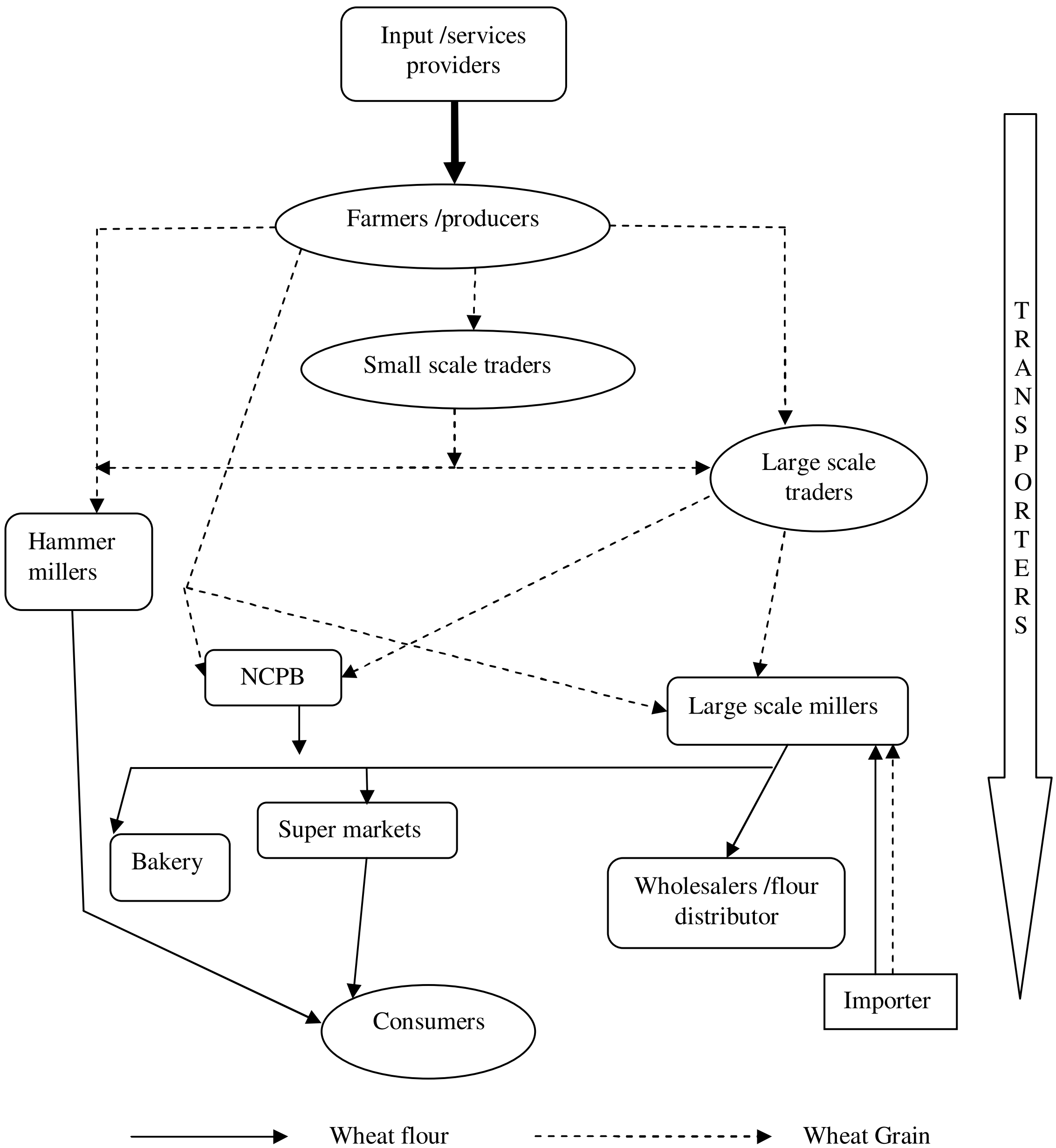

Figure 2.6:Wheat value chain mapping in Kenya

2.2 Rice

The total area under rice cultivation is globally estimated to be 150 million hectares with an annual production averaging 500 million MT. This represents about 29 percent of the total output of grain crops worldwide, (Xu et al., 2003; Tsuboi, 2005). By 2004, more than half of the world's population depended on rice as the major daily source of calories and protein, with a per capita consumption of between 100 and 200 kg. According to projected population growth, the number of people living on rice worldwide is expected to reach 3.5 billion in 2025 (Jian Song, 2003).

Rice is one of the most important food crops in the fight against hunger as more than half of the world's population depended on rice as the major daily source of calories and protein (Jian Song, 2003;FAO, 2008). The total annual world production of milled rice currently stands at 400 million metric tons which compares favorably well with maize and wheat. The area under rice is forecasted to rise by 1.5% (from 153 million hectares to 158.6 million hectares) and yields by close to 1% by 2010. In addition, unlike maize and wheat that are consumed as human and livestock feed, rice remains the most favoured grain globally for human consumption (Ito, 2002). Development of rice therefore presents an opportunity to reduce the number of gravely food insecure people (that stand at 816 million).

Due to the bad weather experienced in South Asian countries during the 2008/09 season, mainly in India, the world rice production fell by 3% to 672 million tons of paddy rice (450 million tons of white rice equivalents). The region represents 30 percent of world production. The world trade in 2009 increased slightly to 30.5 million metric tons. The fall in India's exports may directly benefit Thai and Vietnamese exporters. China is likely to return to the export market due to a larger production (FAO, 2009). China is the leading producer of rice. It produced about 29% of the total world milled rice in 2008 and 2009 as summarized on Table 2.4.

Table 2.4: Rice production and trade (in million MT) among world's major producers

	Production milled rice		Exports		Stocks
Country	**2008**	**2009**	**2008**	**2009**	**2010**
China	133.3	133.4	30.2	30.3	117.4
India	98.9	84.0	2.7	1.5	11.0
Indonesia	38.0	38.4	-	-	3.5
Vietnam	25.8	26.0	4.7	6.5	3.0
Thailand	20.8	20.6	10.0	9.0	4.5
Brazil	8.1	8.6	0.5	0.4	1.1
USA	6.5	7.2	3.2	3.1	1.4
Pakistan	6.5	6.3	2.9	3.0	0.4
Other countries	128.9	125.5			
World	**460.3**	**450.0**			**117.4**

Sources: FAO & USDA. November 2009

Despite the growing demand since 1990, rice production has increased at a lower rate than the population which has raised concern with regards to world food security. Yield gaps can still be observed in several countries, which can be explained by socio-economic and technical constraints. Poor harvests are largely associated with adverse soil and weather conditions, pests and diseases, labor shortages especially with the scourge of HIV/AIDS and other chronic ailments (Dat van, 2000). Global trade in rice consists of only 7% of global production. The global rice market is also characterized by a high level of concentration with only five leading rice exporters (Thailand, Vietnam, India, USA and Pakistan) accounting for more than 66% of global rice exports (FAO, 2005).

Figure 2.7 summarizes the area under rice production, output and yields. From 1961 production and imports have been steadily increasing while area under rice production has slightly increased. Trend analysis shows an increase in production, yields and area by 217%, 131% and 37% respectively.

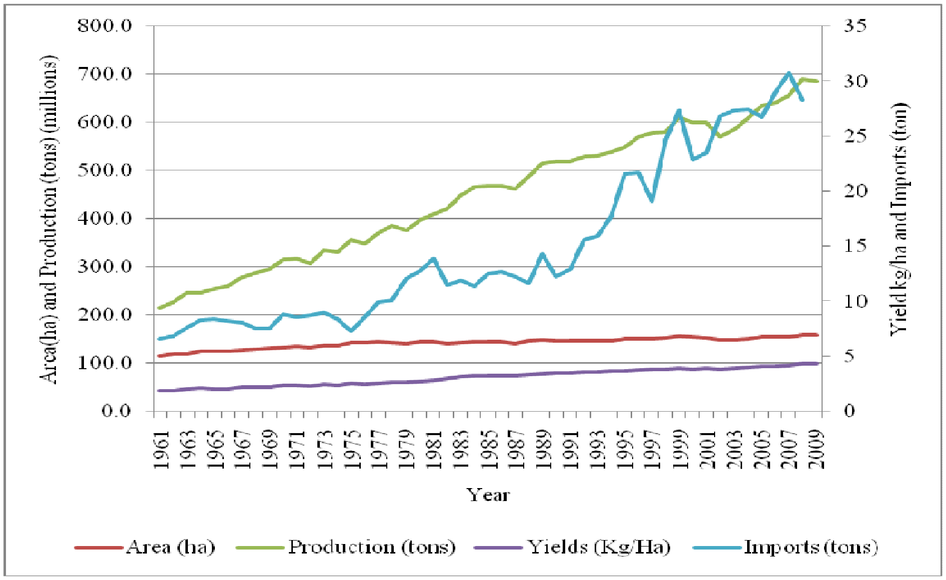

Figure 2.7: Yields, production, imports and area under rice production in the world
Source: FAOSTAT

Kenya imports most of her rice from Pakistan as the country can only meet 20% of it rice requirements. Rice production in Pakistan is done through canal irrigation with the country having the largest single continuous gravity flow irrigation system in the world. The canal traverses about 1.6 million kilometers with more than 700,000 tube wells that pump about 51 billion cubic meters of ground water to supplement the canal supplies. Rice production is the major cropping system in Pakistan covering an average of 2.2 million hectares and providing a livelihood for 15 million with a per capita rice consumption of 16 Kgs (Government of Pakistan, 2007). Between 2000 and 2008, rice yield rose by 8% while the area under production remained constant. In order to motivate farmers to invest in the production of rice through adoption of improved technology, the government of Pakistan uses minimum price support to assure reasonable prices to the producers (these are announced before the growing seasons). With this guaranteed price support, rice farmers are able to produce an exportable surplus, particularly of Basmati, where Pakistan has a comparative advantage. The country is in fact the dominant supplier of the world's premier non-gluteus long grain aromatic rice in the international market (Government of Pakistan, 1996). Since 2000, the government of Pakistan discontinued setting a procurement price for paddy and milled rice and abandoned rice procurement through state trading enterprises. The prices of rice became volatile after the removal of guaranteed price a disincentive to rice farmers. To counter this government re-introduced the guaranteed price support in 2008 to stabilize the prices. The government set a floor price of super basmati at US$ 486 per ton and for the other 385 varieties grown in Pakistan at US$ 390 per ton (Government of Pakistan, 2009).

Between 2000 and 2007, the area under rice production increased by 6%, production increased by 15%, yield increased by 9% while the average consumption of rice during the same period was 3.3million tons per year (Table 2.5).

Table 2.5: Rice production and demand trends in Pakistan

Year	Area '000 (ha)	Production '000 (tons)	Yield (tons/ha)	Consumption '000 (tons)
2000	2,376.60	7,203.90	3.03	2,995.80
2001	2,114.20	5,823.00	2.75	3,346.00
2002	2,225.00	6,717.00	3.02	3,016.00
2003	2,460.60	7,271.40	2.96	3,845.00
2004	2,519.60	7,537.20	2.99	3,621.97
2005	2,621.40	8,320.80	3.17	2,939.90
2006	2,581.00	8,165.00	3.16	3,633.47
2007	2,515.00	8,303.00	3.32	3,757.82
2008	2,962.60	10,428.00	3.52	
2009	2,883.00	10,324.50	3.58	

Source: FAOSTAT, 2009. Data for consumption is not available for 2008 and 2009.

In Africa, rice production increased due to better prices paid to producers. Subsidies for inputs have also helped to improve rice yields. Africa accounts for 10 to 13 per cent of the world population but consumes 32% of the world rice imports with a consumption growth rate of 4.5 percent per annum according to *Africa Rice Center* (WARDA, 2009). Currently; rice is grown in over 75% of the African countries, with a total population close to 800 million people. Rice is the main staple food for the populations in West and North Africa. Across the continent, average per capita consumption is now at 27kg. This is relatively low compared to per capita average of 100kg in Asia (WARDA, 2009).

The West Africa Rice Development Agency (WARDA) with assistance from the International Rice Research Institute (IRRI) embarked on the development of the *New Rice for Africa* (NERICA). This was a wild cross between African and Asian rice, which was high yielding with low input requirements, early maturing, resistant to local stress and higher protein content. The variety was also targeted to upland rice ecology. To date, over 3,000 family lines of NERICA for both uplands and lowlands have been developed. Currently NERICA 1, 2, 3 and 4 are the top varieties planted by farmers in West Africa. While Uganda has already released a NERICA variety known as "NARIC–3" in 2003, other countries like Ethiopia, Madagascar, Malawi, Mozambique, Kenya and Tanzania are evaluating several NERICA varieties for future use.

Most countries in Africa are net importers of rice, with imports of rice to Africa representing a third of the total quantity traded on the global market. This is despite the fact that the continent has a high potential for rice production approximated at 130 million hectares in Sub-Sahara Africa lowlands (WARDA, 2009). Thailand provides the biggest share of rice shipped to Africa approximated to be about 60%, with China and Pakistan providing about 22% and 9%, respectively (FAOSTAT, 2005). Kenya imports about 70% of Pakistan IRRI-6 rice (Business Daily, 2009).

According to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), rice is an important cereal grown and consumed in Uganda since it is considered a potential food security crop in the country. Rice has emerged as one of the crops with the fastest adoption in Uganda because of its attractive returns and contribution to food security. The demand for rice in Uganda now outstrips production, with the current production at 170,000 MT (65,000 MT paddy, 65,000 MT rain fed lowland rice and 40,000 MT rain fed upland rice) while consumption stands at approximately 230,000 MT (MAAIF, 2009). The total area under rice production is about 203,000 hectares with paddy rice covering 58,000 hectares; rain fed upland rice covers 80,000 hectares while rain fed lowland rice covers 65,000 hectares. The production deficit is met through imports mainly from Pakistan, Thailand and cross-border trade from Tanzania. Rice is mainly grown by small scale farmers almost throughout the country but mainly in the Eastern and Western Uganda due to the presence of lowlands with high moisture contents throughout the growing season. About 5% of rice farmers are large scale farmers cultivating over 1,000 hectares. Trading of rice in Uganda is completely under the private sector, especially middlemen who buy threshed rice from farmers at the farm gate. There are some medium and large scale processors who process, package and brand their rice (MAAIF, 2009)

In 2007 MAAIF joined up with other rice stakeholders comprising of farmers, traders, processors, policy makers and donor agencies and formed a Steering Committee for the

Development of the rice industry in Uganda. The committee's mandate is to develop policies and strategies to support the rice industry. Uganda is in the process of implementing the Uganda National Rice Development Strategy (UNRDS) which intends to double rice production between 2009 and 2018. The strategy will be implemented along the whole rice value chain. Due to the increased trend in consumption and importation, rice has become an important crop for research and extension. For a long time, the focus was on lowland rice due to the lack of suitable upland rice varieties, until 2002 when the National Agricultural Research Organization (NARO) started upland rice research resulting in the release of three NERICA varieties. The National Crops Resources Research Institute (NACCRI) has to date released 5 upland rice varieties currently being grown by farmers in Uganda. This has triggered off a renewed interest in rice production mainly due to the stability of farm gate prices, shorter growing periods, sustainable nature of rice as a food-cash crop and higher rate of returns on investment (output- input ratio of 1.83). There has been a rapid expansion of total acreage from 6,000 to about 20,000 hectares between 2005 and 2008 and a reduction in imports rice (Alphonse et al, 2008)

Uganda has fully embraced NERICA rice production and a few studies of its performance have been done. A study done by Kijima et al. (2008) indicated that although NERICA was developed as a stress tolerant variety, it was still susceptible to drought in Uganda. Half of respondents cited inadequate water/rainfall to be the most constraining factor in NERICA production. The use of chemical fertilizers was shown to significantly enhance production, although over two thirds of farmers did not apply chemical fertilizer. Results from Uganda suggest that if Kenya is to promote upland rice, there is need to ensure that farmers use fertilizer and grow it in areas where there is adequate rainfall.

2.2.1 Rice Production in Kenya

Rice is currently the third most important cereal crop after maize and wheat, grown mainly by small-scale farmers as both a food and commercial crop. About 95% of the rice grown in Kenya is from irrigation schemes while the remaining 5% is produced under rain-fed conditions (NIB, 2008). Time series data from FAOSTAT (1960-2009) indicates that area under rice has more than tripled; Trend analysis shows production, area under rice has steadily increased (156% and 241% respectively), while yields have declining gently between 1960 and 2009. The sharp decline in 2009 in production and yield may be attributed to the drought experienced in the country in 2008/2009 (Figure 2.8).

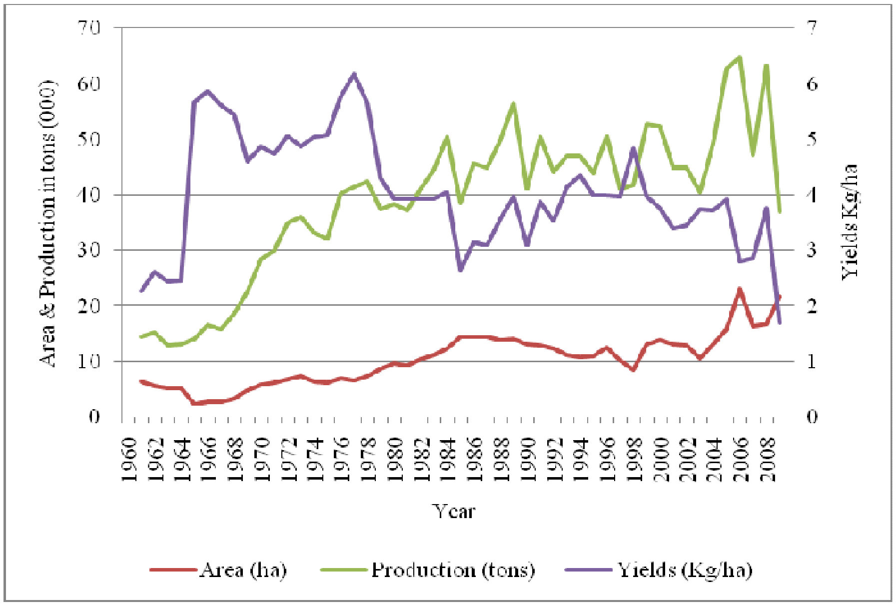

Figure 2.8: Yields, production and area under rice production in Kenya
Source: FAOSTAT, Data on imports is not available

Kenya's expenditures on imported rice increased by 100% between 2003 and 2008 (Statistical Abstract, 2010).According to Ministry of Agriculture the increase in expenditure on imported rice is a result of widening gap between demand and production as a result of a decline in productivity.

The country has a potential of about 540,000 hectares of irrigable and 1.0 million hectare rain fed for rice production (MOA, 2010). With improved water harvesting, storage, underground water resource utilization and innovative management technologies, the current irrigation potential can be increased by a further 800,000 ha to 1.3 million hectare (MOA, 2010). Figure 2.9 summarizes area under paddy, paddy harvested and paddy yields in Kenya from 1964 and 2009. The trend show there has been an increase in area under paddy and paddy harvested from 1964 to 2009 while the yields have been on decline during the same period.

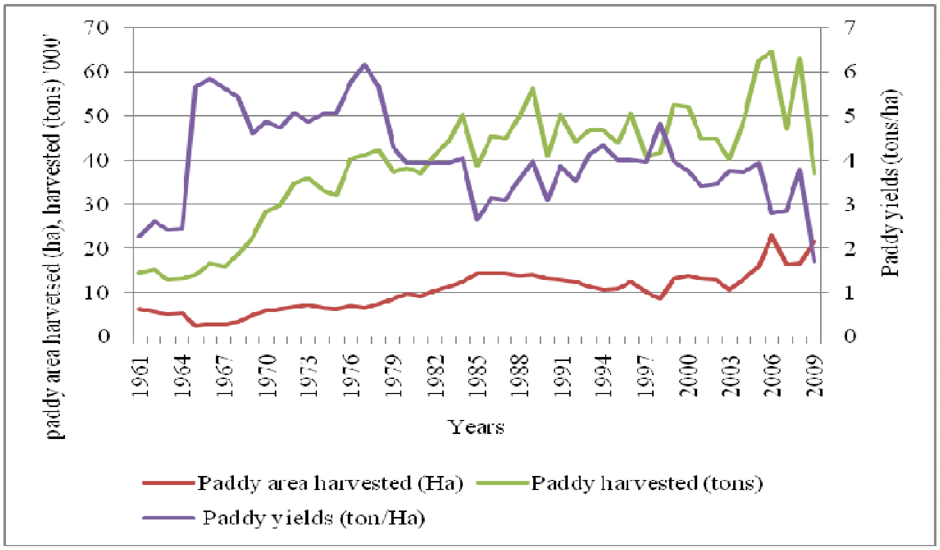

Figure 2.9: Total area of paddy cropped , paddy harvested and yields in Kenya
Source: FAOSTAT

Infrastructure development such as roads, dams, irrigation and drainage, electricity, communication and viable public /private sector partnerships could unlock this potential. After the Tokyo International Conference on Africa Development (TICAD IV) meeting held in Tokyo, Japan in May 2008, the Coalition for African Rice Development (CARD) was formed whose aim was doubling rice production in Sub-Sahara Africa by 2018 by promoting the value chain approach. The secretariat was set up in Nairobi.

The Ministry of Agriculture and the agriculture sector as a whole has been restructured geared mainly towards ensuring food security and poverty reduction. As a result of the restructuring the in the agricultural sector the Ministry has developed a strategic plan (2006–2010) where the Ministry committed to improving service delivery and interventions. These interventions have started yielding fruits. To achieve its strategic plan, the Ministry developed, among other initiatives a National Rice Development Strategy (NRDS)[6]. The strategy has been adopted as a

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[6] NRDS objectives include; increasing rice yields per unit area in both rain and irrigated conditions; improving and expanding irrigation and rain fed rice production; reduction of field and post-harvest losses; sustainable access to affordable credit, high quality inputs and seeds to farmers; facilitate improved production and productivity through extension advisory services and technology development and dissemination; building adequate capacity for rice production; develop and strengthen stakeholder networks and partnership; market and marketing development; and coordinating activities.

living document to guide rice development in the country for the next 20 years. The implementation frameworks for NRDS have also been developed. According to the NRDS, Kenya has the potential to be self-sufficient in rice production.

2.2.2 Rice Value Chain in Kenya

In Kenya, 85% of the rice seed used is sourced from KARI while 15% is from farm saved seed[7] (Ayieko and Tschirley, 2006). Rice is mainly produced by small-scale farmers through four major irrigation schemes. This includes Mwea in Central province, Bunyala in Western, and Ahero and West Kano in Nyanza province. Upland rice is also grown in other parts of the country and this includes; Migori and Kuria in Nyanza province, and Tana Delta and Msabweni in Coast province. Rice is grown by about 300,000 rice farmers, who provide labor and also earn their livelihood from the crop's production (NIB, 2008). Figure 2.10 summarizes the rice value chain.

Rice traders include both large and small scale traders. Large scale traders include major buyers such as the government owned National Cereals and Produce Board (NCPB), National Irrigation Board (NIB) and Lake Basin Development Authority (LBDA); Mwea Farmers' Multipurpose Cooperative Society, Supermarkets in major urban centers, Dominion Farms and Capwell Industries among others. Small scale traders are mainly dominated by women who sell rice in the local markets near the irrigation schemes.

There are four major rice mills spread across the country with varying capacities. Lake Basin Development Authority has a milling capacity of 3.5 metric tons per hour, Mwea rice mills 24 metric tons, Western Kenya Rice Millers 3 metric tons and Tana Delta with 3 metric tons per hour. Additionally there are several small privately owned one pass mills[8] that are located near the schemes especially in Mwea.

[7] Farm-saved seed includes retrained seed, seed purchased from neighbors or local markets but which has not undergone any certification to verify its quality

[8] One pass mill is a simple milling machine that only removes the husks from the paddy rice

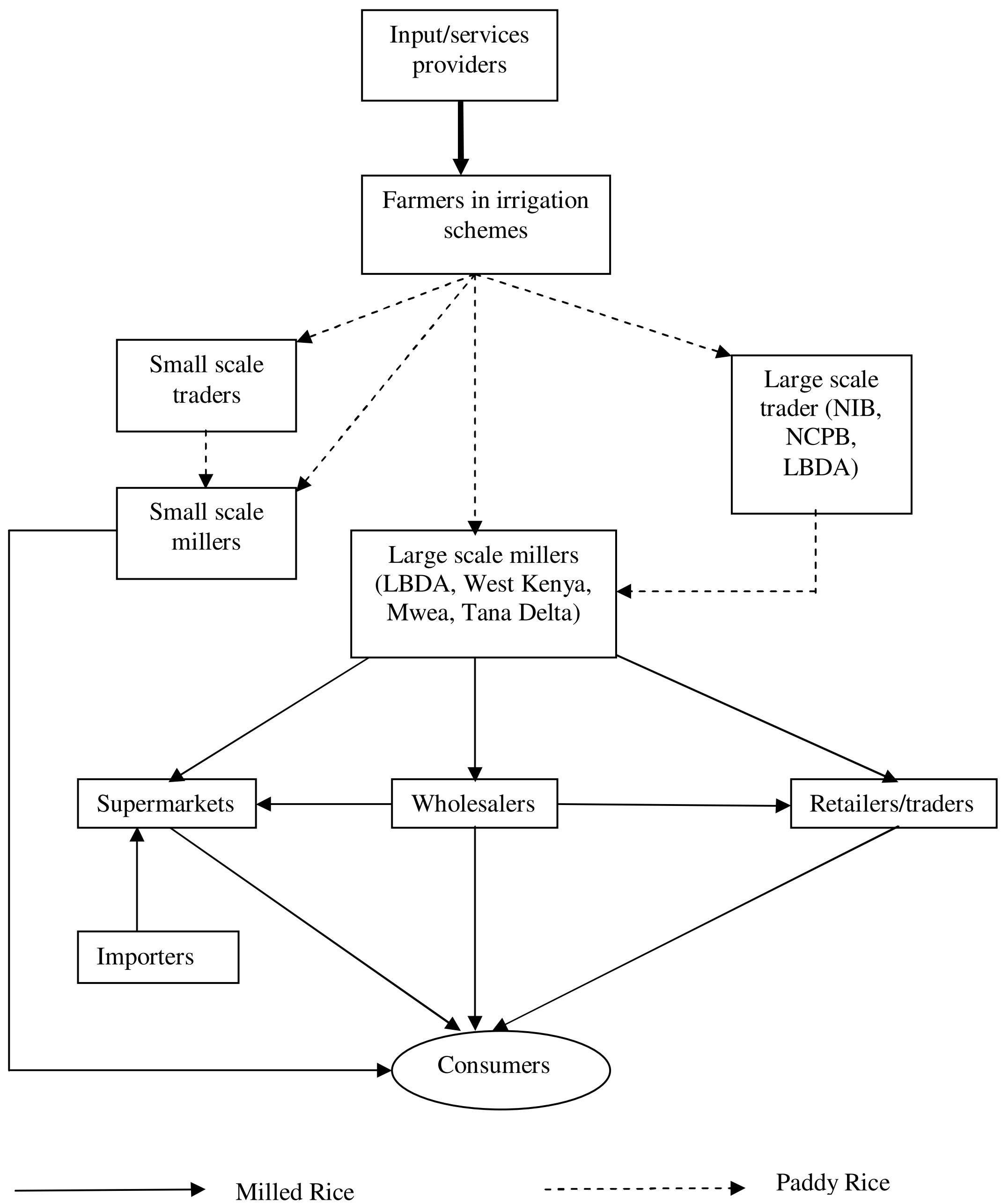

Figure 2.10: Rice value chain mapping for Kenya

3.0 Results and Discussions

All the transactions/marketing costs were estimated cumulatively along nodes of the value chain, from the farm until the products reaches the market. In addition, import parity prices for wheat and rice were computed and compared to domestic prices of locally produced rice and wheat. A case study of upland rice (NERICA) production in Western Uganda and players along the value chain was also analyzed.

This section is organized into two parts. The first part discusses wheat and the second discusses rice. Each part reports farm production costs, transport costs, traders' costs, and a cost build up from the farm gate up to the millers. Finally, to assess the competitiveness of the local production systems, import parity is computed for each commodity and compared to the cost of domestically produced wheat and rice.

3.1 Wheat

3.1.1 Cost of Production

For this study, farmers were categorized into three groups according to technical efficiency scores (efficient, average and least efficient). The calculation of technical efficiency scores is summarized in the Annex. The average acreage under wheat was 7.5, 25, and 150 acres for least, average and efficient farmers respectively. Table 3.1 summarizes test scores for the mean differences between least, average and efficient farmers. The results indicate that the mean difference across the three categories is significantly different at the 5% level.

Table 3.1: Mean difference across the least, average and efficient producers

	(I) NTecheff	(J) NTecheff	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
Tukey HSD	Least efficient	Average	-.08528(*)	.01452	.000	-.1197	-.0508
		Efficient	-.12928(*)	.01367	.000	-.1617	-.0969
	Average	Least efficient	.08528(*)	.01452	.000	.0508	.1197
		Efficient	-.04400(*)	.01473	.009	-.0789	-.0091
	Efficient	Least efficient	.12928(*)	.01367	.000	.0969	.1617
		Average	.04400(*)	.01473	.009	.0091	.0789

*The mean difference is significant at 5%

Using the classification of wheat producers discussed above, cost of wheat production for the three categories of farmers was computed and is summarized in Table 3.2. Although the per-acre production costs of efficient farmers was higher (23%) compared to the least efficient , the efficient farmers produced a bag of wheat at 31% lower costs, harvested 78% higher yields per acre, and earned 68% more profit per bag compared with least efficient farmers. Refer to Table 4 in Annex for simulation of the costs among the three categories of farmers using recently high yielding varieties.

Table 3.2: Wheat costs by efficiency category of producer

Items	**Efficient**	**Average**	**Least Efficient**
Yields (90 kg bag)/acre	16	12	9
Price per bag	2,800	2,800	2,800
Gross Output	**44,800**	**33,600**	**25,200**
Cost of Production/acre			
Machinery operation	5,400	4,200	4,200
Seed fertilizers and chemicals	12,180	11,380	9,180
Labor cost	1,060	920	815
Harvesting costs	2800	2600	2450
Return to Capital	1,577	1,385	1,211
Land rent	4000	4000	4000
Transport to Nairobi	120	150	150
Total production cost	**27,137**	**24,635**	**22,006**
Cost per bag	**1,696**	**2,053**	**2,445**
Profit margin per bag	**1,104**	**747**	**355**

Wheat farming is highly mechanized and requires intensive use of inputs. Results from the survey reflect this (Table 3.3). Labor contribution is minimal while machinery operation and seed, fertilizer and chemicals accounts for the largest share in total costs.

Table 3.3 Proportion of different activities to total costs of production across the three producers

Items	Efficient	Average	Least Efficient
Machinery operation	20	17	19
Seed fertilizers and chemicals	45	46	42
Labour cost	4	4	4
Harvesting costs	10	11	11
Return to Capital	6	6	6
Land rent	15	16	18
Transport to Nairobi	0.4	0.6	0.7

The first inefficiency observed under production was high cost of inputs (machinery operations, seed, fertilizer, chemical and labor). These costs constituted an average of 67% of all the total costs.

A second source of inefficiency was the old age of wheat varieties grown by farmers. About 55% of the farmers have been mainly growing two varieties Kwale and Mwamba. These varieties were released twenty three years ago.Byerlee and Moya (1993) estimated the area-weighted average age of improved varieties at 12-16 years in Kenya and Ethiopia indicating that farmers were growing old varieties. More recently, Gamba et al. (2003) indicated slow turnover of improved varieties as a constraint to production and yield performance. Replacement of one generation of improved varieties with another is known to have contributed a large proportion of the total economic gains from wheat technical change in Asia (Byerlee and Traxler 1995). It appears that the rate of release of new varieties may not be the problem. Only an estimated 9 percent of all improved wheat varieties released in the developing world region between 1996 to 1990 were released in Sub-Saharan Africa (Dixon et al. 2006), but when denominated by the scale of wheat area, the rate of release is high. Relative to other regions of the developing world, Lantican, Dubin and Morris (2005) found relatively high rates of variety release in Eastern and Southern Africa, when adjusted by area, citing the diversity in target environments, the small size of national wheat areas, the enormous variability in disease complexes, and possibly, the active involvement of the private sector in wheat improvement. Nor is it a question of switching to modern wheat varieties. Results from successive surveys carried out by CIMMYT (1990, 1997 and 2002) on the use of modern wheat varieties in developing countries confirmed that all wheat grown in Kenya is improved, and has been from some time. Thus, the inefficiency is the slow replacement of old varieties with newer releases, rather than adoption per se.

Third, wheat farming is a highly mechanized operation. Approximately 30% of the total cost of production was attributed to mechanized operation. High cost of fuel and spare parts resulted in higher costs of hiring machinery. Most of the machinery currently being used (tractors, combine harvesters) are old (twenty years and above). Maintenance costs are therefore high, and these are transmitted to farmers in form of high costs of farm operations (land preparation, planting and harvesting).

3.1.2 Transporter Costs

Transport price is paid by the end users who could be either farmers or traders. Depending on the various nodes along the value chain, the transport price is then compared to the transport costs (Teraveninthorn and Raballand, 2009). According to Teraveninthorn and Raballand (2009), transport costs are disaggregated into vehicle operating costs (VOC) and indirect costs. VOC include various fixed and variable costs of operating vehicles. The fixed transport costs comprise of labor costs, financing costs, depreciation, and administration costs. The variable transport costs include fuel, tires, maintenance, and batteries. Transport costs also include other indirect costs such as road toll, roadblock and weighbridge payments, licenses, and insurance expenses. Unlike maize which usually undergoes various nodes from the farm gate before it reaches the consumers, wheat undergoes much fewer nodes. From the farm, wheat either goes directly to the millers or through traders and then to the miller.

The common mode of transportation used to ferry wheat by the transporters interviewed was 10 metric ton lorry which were at least 20 years old. These were prone to frequent breakdown hence high cost of maintenance. All the transporters interviewed also doubled as traders. Information on transporters collected included yearly kilometers, depreciation; cost incurred in salary, insurance, licenses, taxes, fuel, and maintenance among other costs. Of the total transport cost, variable costs accounted for largest share (75%). Among the fixed costs, the largest share was taken up by administrative costs (29%) followed by salaries to drivers and the turn boy (27%) while among the variable costs fuel accounted for 89% of the total variable costs (Table 3.4). The cost incurred on fuel accounted for 67% of total transport cost. The increase in fuel prices significantly affects the costs of production given that wheat farming is highly mechanized. It was noted that the transporter also incurred non-tariff barrier costs in the forms of road blocks and bribes. This accounted for 3% of the total transport costs.

Table 3.4: Transport cost breakdown per kilometer for 10 metric ton lorry

		Ksh
Fixed Costs	Salary (turn boy/driver)	5.3
	Financing costs	3.9
	Depreciation	4.8
	Admin costs (license, insurance, tax)	5.8
	Total fixed costs	**19.8**
Variable costs	Fuel/oils	53.28
	Tires	1.44
	Maintenance	2.16
	Batteries	0.36
	Road block /bribes	0.9
	Total variable cost	**58.14**
Transport cost		**77.94**
Transport price		**83**
Profit margin		**5.1%**

Note: depreciation[9] of the vehicle was calculated at 12%

From the survey, the transport price for a 90 kg bag of wheat was Ksh 0.75 per kilometer. This translates to Ksh 8.3 per ton per kilometer (transport for 10 metric ton per kilometer is Ksh 77.94). The difference is accounted for by the transporters margin (5.1%). Although the transport margin calculated seems low the transporters indicated that they resorted to other means such as overloading to make profits. For example, a 10 metric ton lorry with a capacity of 110 bags of wheat would be loaded with 130 bags. This translates to a profit of Ksh. 6,200 to Ksh. 8,000 per trip. Also the transporters usually factor in cost paid at roadblocks which are not regularly paid and may carry back goods on return journey.

Inefficiencies encountered by the transporters along the value chain were mainly the high cost of operation as a result of high fuel prices. Thus an increase in the price of fuel will have a significant effect on the total cost of transportation. The domestic fuel prices have continued to increase unabated for the last three years and this cost is transmitted to the farmers and traders along the chain.

[9] The depreciation rate was the common rate that most transporter used in determining their vehicle yearly depreciations.

Another inefficiency encountered by transporters was poor state of the roads, and especially roads connecting farming areas to the markets. Due to the poor state of roads, transporters incurred high costs of maintenance as a result of frequent break down. This was exacerbated by the old age of vehicles used for transportation.

Roads blocks set up for security check on major road was another form of inefficiency that transporters encountered. The transporters were sometimes required to bribe police officers manning the roadblocks to avoid delays in clearing them to pass.

3.1.3 Traders Costs

The survey indicated that the main buyers of wheat from the farmers (small and large scale) are large scale traders. The costs incurred by the traders include, transport price, local council cess, storage and loading and offloading cost. The costs incurred by the traders on a 90 Kg bag of wheat are summarized on Table 3.5 below.

Table 3.5: Costs incurred by the traders on a 90 Kg bag of wheat

Items	Cost per 90 kg bag (Ksh)
Council cess	40
Storage	14
loading/unloading	20
Transport charges	30
Total cost incurred	**112**
Gross income per bag	**200**
Profit margin	**79%**

For traders, the inefficiencies encountered were multiple cess payments, especially when wheat crossed several municipalities. The lack of harmonized charges and interaction between neighboring municipalities has contributed to the multiple cess charges. Another inefficiency faced by the traders was the high transport chargers incurred when transporting wheat to the millers.

3.1.4 Cost Build-up of Wheat from Farm-gate to the Miller (90Kg bag)

From the farm-gate, wheat may be sold to traders who deliver to millers[10] or millers may procure the wheat directly from the farmers. In the case where millers procure directly from the farmers' margins received is relatively higher. Figure 3.1 summarizes the cost-build up and profit margin by player, from the farm-gate to the millers in Nakuru. The cost of production accounts for over half of the mill gate price for all three categories of farmers with the least efficient farmers having the highest costs proportions (81%). This indicates there are high inefficiencies in wheat production as earlier discussed. Efficient farmers made about three times more profit compared to least efficient farmers.

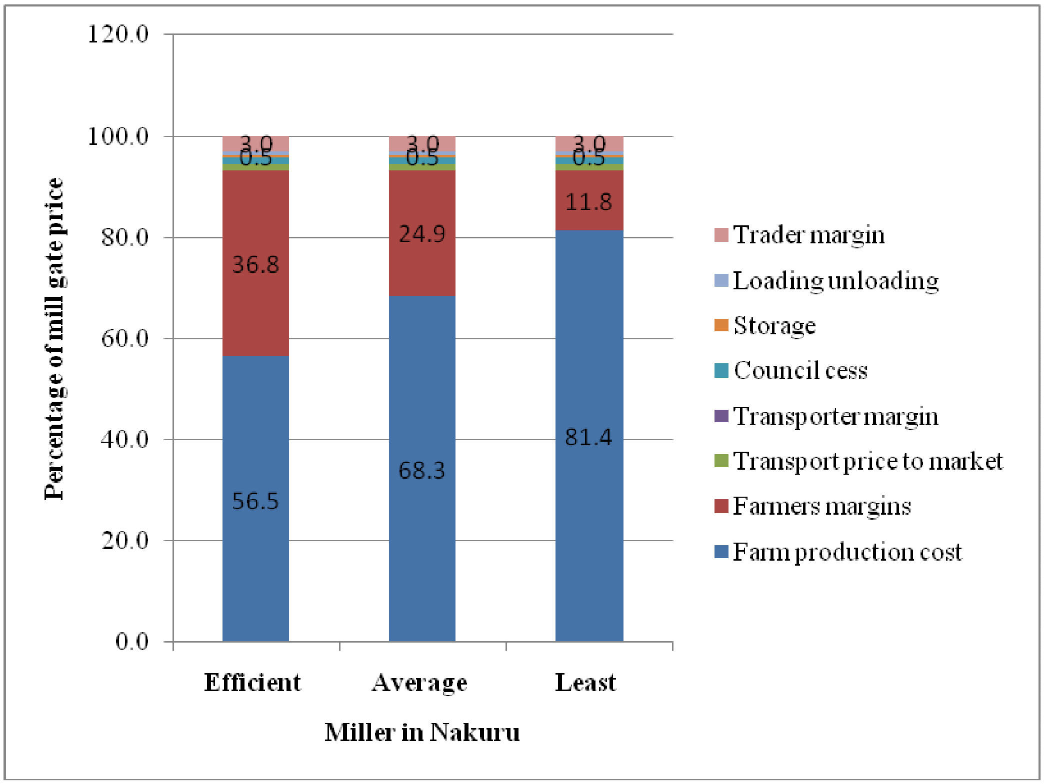

Figure 3.1: Structure of cost for wheat from farm gate to the miller

[10] There were a few hammer mills especially in Nakuru that sourced grain from traders and milled the grains and sold first run wheat flour to consumers.

3.1.5 Competitiveness of Locally Produced Wheat

In order to assess the competitiveness of locally produced wheat compared to imported wheat, an import parity analysis was conducted. The Cost Insurance and Freight (CIF) in July 2010 for wheat Ex US Gulf was US $ 221 per ton and translated to US $ 276 per ton after clearance at the port and transport to the store/warehouse in Mombasa. The price of imported wheat without duty landing in Nairobi is Ksh 2,143 per bag. If a duty of 10% is imposed, the landing price of a bag of wheat to Nairobi is Ksh. 2,306 (Table 3.6).

Table 3.6: Import parity prices for wheat Ex US Gulf - July 2010

Items	US$/ton	Ksh/ton	Ksh/90 kg bag
Basics C&F Price (USD/MT)	220	18,040	1,624
Exchange rate	82		
Insurance (1%)	1	82	7
CIF	221	18,122	1,631
IDF (2.25%)	4.97	408	37
Duty (10%)	22	1,804	162
Port Charges	2	164	15
Levy	0.06	5	0.45
Discharge	8.5	697	63
Terminal handling	7.5	615	55
Health Inspection	0.13	10.5	0.9
SGS certificate (0.475%)	1.05	86	8
Handling charges	1.35	111	10
PP bags	4.34	356	32
Freight port to warehouse	2.74	225	20
Miscellaneous	0.24	20	2
Total Duties and port charges	54.88	4500	405
Finance charge	275.88	22,622	2,036
GBHL loss (0.05%)	0.14	11.31	1.02
Landed in store Mombasa	276.02	22,633	2,037
Transport cost to Nairobi	36.4	2,985	269
Landed Nairobi with duty	312.4	25,618	2,306
Landed Nairobi without duty	290.4	23,814	2,143

Source: Louis Dreyfus, EAGC CMA and authors' compilation

The competitiveness of domestic wheat was assessed by comparing local costs of production computed earlier in Table 3.2 with import parity in Table 3.6. With the current import duty of 10% levied on imported wheat, only the efficient and average farmers would be competitive, with a markup[11] of 36% and 13%, respectively. If imported wheat is zero-rated, only the efficient and average farmers are competitive, with a markup of 26% and 4%, respectively (Table 3.7).

Table 3.7: Competitiveness of domestic wheat compared to imports

		Cost in Ksh/90 Kg bag		
Imported	Landed price in Mombasa store		2,037	
	Landed price Nairobi (with 10% duty)		2,306	
	Landed price Nairobi without duty		2,143	
		Efficient	**Average**	**Least efficient**
Domestic	Landed price in Nairobi	1,696	2,053	2,445

Source; Author compilation

The country is a net importer of wheat and thus Kenya is susceptible to international world prices. The results from the survey show that with the prevailing prices in July 2010 of US$ 220 per ton, it is only the average and efficient producers that are competitive. With the wheat export ban in Russia in August 2010 the international prices of wheat were rising. This is good news to the local producers given that a ton of wheat in September, 2010 was US$ 310 per ton. At this price the landed price of wheat in Nairobi with duty was at Ksh. 3,055 and without Ksh. 2,866. Given the prevailing duty all the wheat producers would be competitive in both scenarios. With 10% import duty imposed the producers were competitive with 80%, 49% and 25% markup for efficient, average and least efficient farmers respectively. Without duty all the producers were competitive with 69%, 40% and 17% markup respectively (Refer to Table 2 in Annex for more details).

Import duties are short term policy instruments. This policy instruments may not be available in the near feature as Kenya is a member of several trade blocs. The trend in most of the trade blocs is to move towards a free movement of goods within member states. The government needs to address the inefficiencies along the value chain for the locally produced wheat to be competitive. From the results it shows that there are groups of farmers that are producing wheat competitively under the current situation. Some good practices learnt from these farmers could be replicated in

[11] Considering the landed price in Nairobi of a 90 kg bag of imported wheat as the prevailing selling price

other farms. The category of farmers' not producing wheat competitively may switch to other higher value crops as a source of income for the households.

3.2 Rice

3.2.1 Cost of Production

The cost of rice production was estimated for the Basmati rice variety under two irrigation schemes (Mwea and Ahero). In the two schemes, some farmers were also growing NERICA and IR 2793 varieties. The cost of production for the three types of milled rice grown in the schemes is summarized on Table 3.8. In the Mwea scheme, fertilizer costs were highest for the two varieties grown while in Ahero scheme fertilizer costs were high for one variety. Bird chasing was a significant activity in rice production in both schemes.

Table 3.8: Proportion of total cost of production of milled rice in Mwea and Ahero scheme

	Mwea		Ahero	
Activity	**Basmati**	**NERICA**	**IR 2793**	**Basmati**
Fertilizers	32	29	27	19
Weeding	15	20	14	8
Chasing birds	15	25	11	15
Land preparation	13	6	18	6
Planting	11	8	7	12
Harvesting	10	10	18	22
Seeds	4	1	5	19
Total	**100**	**100**	**100**	**100**

Mwea Irrigation Agricultural Development (MIAD) develops a guide for inputs use and gross margins per acre for farmers in the schemes (Refer to Annex). This is usually done every year. Using the MIAD input use guide, interviewed farmers were categorized into three groups; low, average and high input users. Cost of production for the three categories of farmers is summarized on Table 3.9. The cost of production per acre for high input users was 7% higher than that for low input users. These high input users produced a bag of milled rice at 54% less and made 57% more revenue per bag compared to the low input users.

Table 3.9: Cost of production for milled rice for the different categories of producers

Item	Low Input user	Average	High Input users
Rice Yields (50 kg bags)	20	25	33
Price/bag	4,400	4,400	4,400
Gross output	**88,000**	**110,000**	**145,200**
Costs of production			
Land preparation	4,300	4,200	4,300
Seeds, Fertilizers and chemicals	12,500	13,150	13,410
Labor costs	17,900	18,100	18,950
Rent	25,000	25,000	25,000
Gunny bags	700	875	1,155
Transport from farm	1,000	1,250	1,650
Milling cost	2,000	2,500	3,300
Transport to Nairobi	40	40	40
Total cost	63,440	65,115	67,805
Overheads (10%) of total cost	6,344	6,512	6,781
Total cost of production per acre	**69,784**	**71,627**	**74,586**
Revenue per acre	**18,216**	**38,374**	**70,615**
Cost per bag	***3,489***	***2,865***	***2,260***
Revenue per bag	***911***	***1535***	***2140***

Farm budgets for NERICA rice production in Kenya and Uganda shows that the cost of producing a bag of milled NERICA rice in Kenya was 21% higher compared to Uganda. Though the cost of production was high in Kenya, the revenue earned per bag of milled rice was 8% higher in Kenya compared than in Uganda. The cost of labor in both countries was above 50% of the total cost of production and indication that the upland rice is also labor intensive. Production cost of upland rice per acre was 56% less compared to paddy rice.

The first inefficiency faced in paddy rice production is that it is labor intensive. Labor costs contribute to 56% of the total costs. An opportunity to reduce these costs does therefore present itself through potential use of appropriate machinery to carry out some of the activities. In Uganda for example, there are several varieties of NERICA rice released for commercialization but most private companies have shied away from bulking seed due to high costs involved (costs of chasing birds).

The second inefficiency in rice production was the high cost of inputs. As a result farmers were not using the recommended rates thus resulting in low yields. The third inefficiency in rice production was sub-division of land into smaller units. As a result there has been increased in demand for water. With the change in weather patterns this has exacerbated the situation leading to water rationing. This has affected the intensity in paddy production with some farmers abandoning rice production completely.

Poor irrigation infrastructure and uneven distribution in the rice mills were the inefficiencies pointed out by farmers. Rising prevalence of water borne diseases such as malaria and bilharzia in the schemes has affected the availability and productivity of labor force. This problem is critical given the labor-intensive nature of rice production.

3.2.2 Transport Price

Unlike in wheat, most of the traders and millers of rice were situated near the rice farms. Thus transport cost was minimal. It was a common practice in Kenya and Uganda for traders or millers to pay for transport cost as an incentive to ensure farmers delivered paddy rice to them. The transport price for an 80 Kg bag of paddy rice[12] was Ksh. 60 in Kenya and Ksh. 40 in Uganda[13]. The study team did not however manage to interview transporters in Kenya and Uganda along the value chain because they were not available as the survey was carried during an off-season (transporters operate mainly during harvesting period).

3.2.3 Trader Costs

Both small and large scale traders were operating in Mwea and Ahero irrigation schemes in Kenya. The difference between the two categories of traders was in the volumes of rice handled and the structure of operation. Large scale traders handled an average of 57.3 tons per month and operated from permanent structure (shops) while small scale traders handled 4.5 tons per month and operated in the open. The cost of milling a kilogram of paddy was Ksh. 2 in Kenya. In Uganda, traders were mainly small scale and were operating in the open and the price of milling a kilogram of paddy was Ksh. 4. Small scale traders in Kenya and Uganda had similar activities except for drying. In Kenya, drying of paddy rice was usually done by the traders as they purchase the paddy immediately it is harvested while in Uganda farmers usually dry the paddy

[12] 80 Kg bag was the standard of measurement used to measure paddy rice harvested in Kenya and Uganda
[13] The exchange rate used was 1 Ksh equivalent to 25 Ush

before it was purchased. In Kenya the largest cost component incurred by both the small and large scale traders was milling costs, accounting for 68% and 72% of the total costs, respectively (Table 3.10). Similarly, in Uganda milling cost accounted for the largest share (89%) in total costs.

Table 3.10: Overhead costs (Ksh.) incurred by traders in Kenya and Uganda (80 Kg/bag paddy)

	Kenya		Uganda
Item	**Small scale**	**Large scale**	**Small scale**
Milling	160	160	320
Drying	46.2	22.5	0
Unloading	8.2	19.7	40
Loading costs	8.2	16.4	40
Storage fees	0	11.5	0
Watchman	0	5.4	0
Licensing fees	0	1.2	0
Electricity	0	0.3	0
Total overhead costs	***222.7***	***237***	***360***
Cost of paddy	***2,400***	***2,400***	***3,200***
Overall costs	***2,623***	***2,637***	***3,600***
Gross output	***4,400***	***4,400***	***3,876***
Profit margins	***68%***	***67%***	***8%***

Inefficiencies faced by traders in Kenya included high cost of electricity which translated to high milling costs. Second inefficiency faced by traders was high cost incurred in drying paddy rice.

3.2.4 Rice Millers

The study team identified three categories of rice millers. Small scale millers had at least a simple mill, weighing scale and a drying yard. A medium scale miller has at least rice milling chain or compound rice mill, drying yard, pre-cleaner, husker, destoner, grader, bucket elevators, a weighing scale, and a packaging unit. A large scale miller owns at least rice milling chain or compound rice mill, drying yard, mechanical dryer, pre-cleaner, husker, destoner, colour sorter, bucket elevators, a weighing scale and a packaging unit.

In Kenya, both medium and small scales millers were interviewed. The mills were operated at different capacities and at varying conversion[14] rates. In Mwea scheme, medium scale millers interviewed had an average milling capacity of 2,235 tons of paddy rice (1,341 tons milled rice) per month while in Ahero scheme, the milling capacity was 203 tons of paddy rice (121 tons of milled rice). The cost of milling a kilogram of paddy in Kenya was Ksh. 2. Recently there has been an increase in the number of millers in the schemes and this has been made possible through importation of diesel operated rice mills from China. The diesel operated mills can be set up even in areas where there is no electricity.

In Uganda, medium scale millers were interviewed. The cost of milling a kilogram of paddy in Uganda was Ksh. 4. Diesel operated mills are also very popular here and the millers attributed this to lack of electricity in many parts of rural areas in Uganda. Where electricity was available, especially in towns, millers reported that it is often interrupted as a result of power rationing by the national power supplier. Stiff competition has lead miller to offering other services such as transport and storage facilities as incentives to farmers. Some millers only operated during peak periods. In both countries, millers were selling by-products from rice, such as husks, rice germ and broken rice grains to traders as livestock feeds. Labor constituted the highest cost incurred in Kenya (50%) while in Uganda it was electricity (82%). In Kenya, millers incurred 143% more overhead costs compared to their counterparts in Uganda (Table 3.11). All millers interviewed in Uganda were operating from wooden structures while their counterparts in Kenya operated from permanent structures

Table 3.11: Overhead costs (Ksh.) incurred by medium scale millers in Kenya and Uganda (80 Kg/ bag paddy rice)

Cost item	Kenya	Uganda
Labor costs	141.7	3
Electricity	53.9	95
Rent	50.2	7
Maintenance	21.3	1
Storage	12.3	
Licensing fees	2	9
TOTAL	**281.4**	**115.5**

[14] The average conversion rate from paddy to milled rice was 60% (1 bag of paddy yielded 0.6 bag of milled rice)

Costs and returns from the sale of one kilogram of milled rice by the small scales miller in Kenya are summarized on Table 3.12. The millers made 58% and 59% profit from the sale of aromatic and non-aromatic rice, respectively.

Table 3.12: Cost and return (Ksh) by small scale millers per kg of milled rice in Kenya

Cost/Return	Aromatic	Non-Aromatic
Selling price/kg	110	65
Purchase price/kg	40	20
Milling cost/kg	2	2
Overhead cost/kg	5	5
Total cost incurred	**47**	**27**
Margins per kg	**63**	**38**

Inefficiencies faced by the millers was the high cost of electricity and high cost of maintenance as a result of frequent breakdown as the compound mills were old and their spare parts were not readily available locally. To break-even, millers also traded rice (they would purchase paddy, mill it and sell to consumers) and remain closed during the off-season. In both Kenya and Uganda, many millers had opened up shops when cheaper, diesel-operated mills became available. Most mills were operating below their installed capacities because of stiff competition.

3.2.5 Rice Cost Build-up from Farm-gate to Consumers for Rice

During the survey, two channels of rice distribution to consumers were observed. In the first channel, farmers sold their paddy rice to traders (who owned rice mills). In the other channel, farmers sold their paddy directly to millers. In both channels, the traders/ miller collected the paddy rice from the farmers. Figure 3.2 summarizes the cost build-up of a 50 kg bag of milled rice from farmer to the consumer. Of the price paid by consumers, the costs of production account for over 60% for farmers that used average or low inputs in their farms. Farmers who used high inputs had the highest mark-up (45%) compared to both average (32%) and low input users (19%).

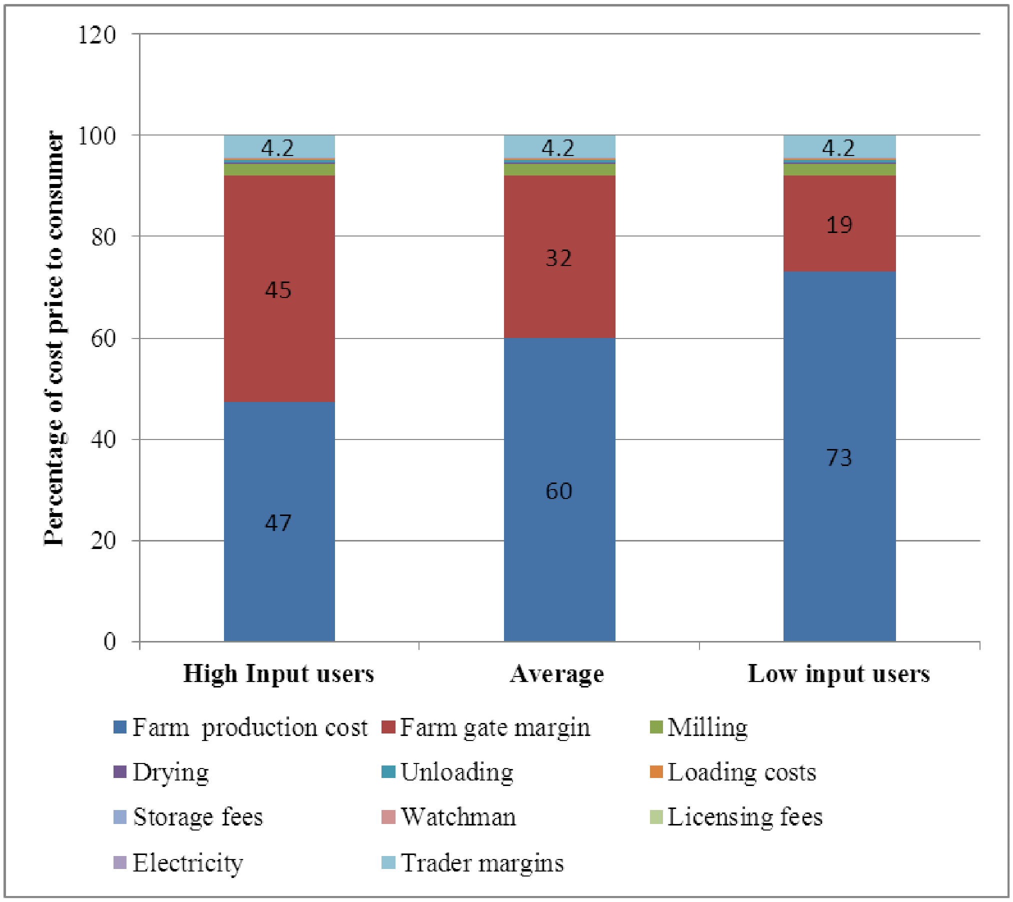

Figure 3.2: Cost build-up from farmers to consumer in Kenya (50 Kg milled rice).

3.2.6 Competitiveness of Locally Produced Rice

As with wheat, the study sought to assess the competitiveness of locally produced rice through a cost built-up and import parity analysis. As at August 2010, the price of imported rice CIF Mombasa was US$ 515 per ton which translates to US$ 753 after clearance at the port and transport to the store/warehouse in Mombasa. With an import duty of 35%, imported rice from Pakistan lands in Nairobi at Ksh. 2,425 without duty and if duty is imposed, at Ksh 3,146 per 50 kg bag (Table 3.13).

Table 3.13: Import parity prices for rice Ex Pakistan August 2010

Items	US $/ton	Ksh/ton	Ksh/50 kg bag
FOB price	445	35600	1780
Exchange rate	80		
Freight	70	5,600	280
C& F Mombasa	515	41,200	2,060
Insurance (1% C &F)	5.2	412	21
Import duty (35%)	180.25	14,420	721
IDF fees (2.25% C&F)	12.875	1,030	52
KPA handling charges	28	2,240	112
KARI (1% C& F)	5.2	412	21
Min. of Health (0.2% of C&F)	1	82	4
Bagging charges	0	-	-
Transport to warehouse	3	240	12
Storage and handling charges	1.5	120	6
Fumigation charges	1.5	120	6
Landed into store Mombasa	753	60,276	3,014
Road haulage to Nairobi	33	2,640	132
Landed Nairobi with duty	***786***	***62,916***	***3,146***
Landed Nairobi without duty	***606***	***48,496***	***2,425***

Source: Louis Dreyfus and Author compilation

To determine the competitiveness of domestic rice production, the price of a 50kg bag of imported, milled rice was compared to locally-produced milled rice (Table 3.14). If no duty is imposed, only the high input users were competitive with a mark-up of 8%.With a 35% duty on imported rice, only high and average input users are competitive with a mark-up of 39% and 10% respectively.

Table 3.14: Competitiveness of domestic rice compared to imports.

			Cost in Ksh.	
Pakistan rice	Landed price in Mombasa store 50 kg bag		3,014	
	landed price Nairobi (with 35% duty) 50 kg bag		3,146	
	Landed price Nairobi (without duty) 50 kg bag		2,445	
		High input user	**Average**	**Low input user**
Domestic	Landed price Nairobi 50 kg bag	2,260	2,865	3,489

With an import duty of 75%[15], all the three category of farmers would be competitive. As discuss earlier import duties are short term policies. There is need for long term solution in the sector to address inefficiencies along the value chain for the locally produced rice to be competitive. There are farmers that are producing rice competitively, thus need to learn good practices from these farmers and replicate and upscale them.

[15] This was the import duty prevailing before 2010/11 budget speech. The import duty was revised from 75% to 35% during the 2010/11 budget speech in June 2010

4.0 Conclusion and Policy Implication

With the persistent dependence on maize for food security in Kenya, it is becoming increasingly important to increase production of other staples like wheat and rice. Currently, wheat and rice are second and third most important staple foods consumed in the country after maize, yet the country currently meets only about 40% and 20% of its consumption needs in these crops, respectively. This structural deficit, highlighted by the global food price crisis of 2007-8 that may easily recur in the future, motivated the analysis presented in this paper.

The study set out to assess the competitiveness of Kenya's wheat and rice production systems with a view to identifying areas of inefficiency that require attention by policy makers and other stakeholders in order to ensure increased competitiveness and hence local production in these commodities. The results of the study indicate that Kenya is barely competitive with regard to both wheat and rice production. In addition, there exist differences in the country's competitiveness in these commodities depending on farmer category and import duty imposed. Several inefficiencies along the two value chains were also identified and analyzed.

In wheat production, there were a number of inefficiencies along the value chain contributing to this lack of competitiveness. In production the inefficiencies included high input costs (fertilizers, chemicals and seeds), high cost in machinery operation as a result high fuel prices and maintenances (costly spare parts) as machinery being used by the farmers are old (twenty years and above). Despite complete adoption of high-yielding seed, the replacement by farmers of old varieties with newly released materials is slow, leading to more damage from pests and diseases and lower yield potential. Due to inefficiencies in production, the cost of production represents over half of the mill gate price of wheat. In transportation, inefficiencies included high costs of transport as a result of high fuel prices, poor roads especially the roads connecting wheat producing areas to the markets, and many (some of which are unnecessary) road blocks which results into delays in deliveries. Bribery at the road blocks also add to costs of transport. Traders along the chain were levied multiple taxes by the local authorities. This occurred where wheat purchased crossed several municipalities.

In rice production inefficiencies along the value chain included high cost of labor due to lack of sufficient labor as a result of high rural urban migration of the labor force and increase in the prevalence of water borne diseases, high costs of inputs (fertilizer, chemical and seeds) leading to low application rates and poor yields, and changing weather patterns, which has reduced the level of water flowing to the schemes, leading to rationing of the available water. Among traders and millers, inefficiencies includedthe high cost of electricity and labor. For transporters, high cost of fuel, poor state of the roads and high costs of spare parts were the key inefficiencies

For Kenya to be domestically competitive in rice and wheat production there is need to address the inefficiencies along the value chain in the two sub-sectors using short term and long term policy instruments. In the wheat sub-sector in the short run, the high costs can be reduced through duty waiver on agricultural machineries, spare parts, chemicals and fertilizer and bulk purchase and importation of inputs to take advantage of economies of scale. To counter high cost of fuel, the government needs to streamline and improve procedures of importation and release of the fuel from the Mombasa depot into the market. Due to inefficiencies, there is a lag between the arrival of crude oil, refining and releasing of the stocks to the market hence creating an artificial shortages that leads to the increase in the pump prices. There is also need to harmonize taxation across municipalities to avoid double taxation especially where produce is being moved across several municipalities.

In the medium /long term, the government needs to give priority to increasing funding for research and development. Also the government needs to create an enabling environment for private sector to invest in research and development as this is a capital intensive undertaking. Kenya's challenge is not the adoption of high yielding variety but rather the slow replacement in older high yielding varieties. There is need to ensure the new high yielding varieties produced are adopted by the farmers. This may be achieved through better linkages between research and extension, and more innovative forms of extension. Investment in irrigation infrastructure to reduce dependency on rain fed agriculture cannot be overemphasized, given the increasing unpredictable weather due to climate variability and change.

In rice some of the short term policy instruments include measures to reduce of the high cost of inputs, including fuel which will also lead to lower electricity costs as diesel generators are used to generate electricity when the country is experiencing drought; embarking on campaign to eradicate water borne diseases in the rice growing schemes; and adoption of simple technology especially from Asia that can be used to carry out most activities in rice production. In the medium / long term there is need to develop alternative cheap sources of energy, such as solar, wind, geothermal and nuclear that will complement the source of electricity. Investment in research and development to produced high yielding varieties and ensuring farmers have adopted them is also useful strategy. Rehabilitating the current irrigation infrastructure and expanding irrigation to more land and investing in the processing, branding and marketing activities in the rural rice growing to create more employment opportunities are other measures worth pursuing. These are some long term measure that may help make the country be more competitive in rice production.

With regards to both wheat and rice, results have shown that there are groups of farmers that are producing these two commodities competitively. There is need to learn from these farmers on good practices that can be replicated and up scaled in other farms. For the that cannot be able to produce wheat and rice competitively they may switch to other high value crops. Import tariffs to protect the local producers of both wheat and rice are short term policy instruments that may not be sustainable given global trends where trade partnerships are being forged with countries becoming and advocating more open trade. Medium and long term measures that address the inefficiencies along the value chain and addresses challenges facing the wheat and rice sub-sectors will ensure Kenya competitiveness in the production of these commodities and also address issues of food insecurity.

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Annexes

Methodology of computing Technical efficiency[16]

Empirical Framework: Stochastic Frontier Production and Cost Functions

As in Bravo-Ureta and Evenson (1994) and bravo-Ureta and Rieger (1991), the parametric technique used in this study follows the Kopp and Diewert (1982) cost decomposition procedure to estimate technical, allocative and economic efficiencies.
The firm's technology is represented by the stochastic frontier production function as follows;

$Y_i = f(X_i;\beta) + e_i$ *(Equation 1)*

Where Y_i is the output of the i[th] farmer
X_i is a vector of input quantities of the i[th] farmer
β is a vector of unknown parameters to be estimated.

$e_i = (V_i - U_i)$ *(Equation 2)*

V_i are assumed to be independent and identically distributed $N(0, \sigma^2_v)$ random errors independent of the U_i. U_i are non-negative technical inefficiency effects representing management factors and are assumed to be independently distributed with mean u_i and variance σ^2.
The *i*th farm exploits the full technological production potential when the value of U_i comes out to be equal to zero, and the farmer is then producing at the production frontier beyond which he cannot produce. The greater the magnitude of U_i far away from the production frontier will the farmer be operating more inefficiently Drysdale et al., (1995) The maximum likelihood estimation of Eq. (1) provides estimators for the betas. The variances of the random errors σ^2_v and that of the technical and allocative inefficiency effects σ^2_u and overall variance of the model σ^2 are related thus:

$\sigma^2 = \sigma^2_v + \sigma^2_u$ *(Equation 3)*

[16] The methodology is adopted from Samuel Mburu's thesis who is a co-author in this paper for.

The ratio $\gamma = \sigma^2_u / \sigma^2$, measures the total variation of output from the frontier which can be attributed to technical or allocative inefficiency (Battese and Corra, 1977).

Subtracting v_i from both sides of eq.(1) yields;

$$Y^*_i = y_i - v_i = f(X_i;\beta) - U_i) \qquad \textit{(Equation 4)}$$

Where Y^*_i is the observed output of the i[th] firm, adjusted for the stochastic noise captured by v_i.

Equation (4) is the basis for deriving the technically efficient input vectors and for analytically deriving the dual cost frontier of the production function represented by Equation (1). For a given level of output Y^*_i, the technically efficient input vector for the i[th] firm, X^t_i is derived by simultaneously solving Equation (4) and the ratios $X_1/X_i = k_i$ $(i>1)$ where k_i is the ratio of observed inputs X_1 and X_i. Assuming that the production function in Equation (1) is self-dual, the dual cost frontier can be derived algebraically and written in a general form as;

$$C_i = f(P_i;\ \alpha,\ Y^*_i;\alpha) \qquad \textit{(Equation 5)}$$

Where C_i is the minimum cost of the i[th] firm associated with output Y^*_i, P_i is a vector of input prices for the i[th] firm and α is a vector of parameters.The economically efficient input vector for the i[th] firm, X_i^e is derived by applying Shephard's lemma and substituting the firm's input prices and output level into the resulting system of input demand equations;

$$\frac{\partial C_i}{\partial P_i} = X_i^e (P_i, Y^*_{i,};\ \upsilon) \qquad i=1,2\ldots,m \text{ inputs} \qquad \textit{(Equation 6)}$$

Where υ is a vector of parameters. The observed, technically efficient and economically efficient costs of production of the i[th] firm are equal to $P_i`X_i$, $P_i`X^t_i$, and $P_i`X^e_i$, respectively. These cost measures are used to compute technical (TE) and economic (EE) efficiency indices for the i^{th} firm as follows;

$TE_i = P_i`X^t_i / P_i`X_{i,}$ *(Equation 7a)*

$EE_i = P_i`X^e_i / P_i`X_{i,}$ *(Equation 7b)*

Following Farell (1957), the allocative efficiency (AE) index can be derived from Eqns (3.10a) and (3.10b) as follows;

$AE_i = P_i`X^e_i / P_i`X^t$ *(Equation 8)*

Thus the total cost or economic efficiency of the i^{th} firm ($P_i`X_{i,} - P_i`X^e_i$) can be decomposed into its technical ($P_i`X_i - P_i`X^t_i$) and allocative ($P_i`X^t_i - P_i`X^e_i$) components.

Table 1:Technical and economic efficiency of the wheat producers

	Efficiency			Efficiency			Efficiency	
Producers	Technical	Economic	Producers	Technical	Economic	Producers	Technical	Economic
Least	0.8	0.4	Average	0.87	0.86	Efficient	0.89	0.88
Least	0.8	0.5	Average	0.87	0.86	Efficient	0.89	0.88
Least	0.8	0.6	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.6	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.6	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.7	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.7	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.86	Efficient	0.9	0.88
Least	0.8	0.8	Average	0.87	0.87	Efficient	0.9	0.89
Least	0.81	0.8	Average	0.87	0.87	Efficient	0.9	0.89
Least	0.82	0.8	Average	0.88	0.87	Efficient	0.9	0.89
Least	0.84	0.8	Average	0.88	0.87	Efficient	0.9	0.89
Least	0.84	0.8	Average	0.88	0.87	Efficient	0.9	0.89
Least	0.84	0.8	Average	0.88	0.87	Efficient	0.91	0.89
Least	0.85	0.8	Average	0.88	0.87	Efficient	0.91	0.89
Least	0.85	0.8	Average	0.88	0.87	Efficient	0.91	0.89
Least	0.85	0.8	Average	0.88	0.87	Efficient	0.92	0.89
Least	0.85	0.81	Average	0.88	0.87	Efficient	1	0.89
Least	0.85	0.82	Average	0.88	0.87	Efficient	1	0.89
Least	0.86	0.83	Average	0.88	0.87	Efficient	1	0.89
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.84	Average	0.88	0.87	Efficient	1	0.9
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.9
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.91
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.91
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.91
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.91
Least	0.86	0.85	Average	0.89	0.87	Efficient		0.91
Average	0.87	0.86	Average	0.89	0.87	Efficient		0.92
Average	0.87	0.86	Efficient	0.89	0.88	Efficient		0.93
Average	0.87	0.86	Efficient	0.89	0.88	Efficient		0.93
Average	0.87	0.86	Efficient	0.89	0.88	Efficient		0.95
Average	0.87	0.86	Efficient	0.89	0.88	Efficient		0.95
Average	0.87	0.86	Efficient	0.89	0.88	Efficient		1

Table 2: Import Parity Prices for wheat Ex US Gulf September 2010

Items	US$/ton	Ksh/ton	Ksh/90 kg bag
Basics C&F Price (USD/MT)	310	25,420	2,288
Exchange rate	80		
Insurance (1%)	1	82	7
CIF	311	24,880	2,239
IDF (2.25%)	7.00	560	50
Duty (10%)	31	2,480	223
Port Charges	2	160	14
Levy	0.06	5	0.45
Discharge	8.5	680	61
Terminal handling	7.5	600	54
Health Inspection	0.13	10.5	0.9
SGS certificate (0.475%)	1.47	118	11
Handling charges	1.35	108	10
PP bags	4.44	356	32
Freight port to warehouse	2.81	225	20
Miscellaneous	0.25	20	2
Total Duties and port charges	66.52	5322	479
Finance charge	377.52	30,202	2,718
GBHL loss (0.05%)	0.19	15.10	1.36
Land Cost Mombasa	**377.71**	**30,217**	**2,720**
Transport cost to nairobi	36.4	2,912	262
Landing Cost Nairobi with duty	**414.1**	**33,129**	**2,982**
Landing cost Nairobi without duty	**383.1**	**30,649**	**2,758**

With the export ban in Russia (Aug –Dec 31st 2010). The price of wheat has been on the rise and by September 2010 the price per ton of wheat was US$ 310. Table 2 summarizes costs incurred on imported wheat. As shown on Table 3 with a 10% duty imposed on imported wheat all the three categories of farmers are competitive. The three categories are also competitive even when the wheat is zero rated. But as discussed earlier this are short term prices that cannot be maintained for a long time. The world has a experienced two seasons consecutively of a bumper harvest (surplus stocks) and also supply response from wheat producing countries. Thus least efficient farmers are only competitive at a high international price of wheat.

Table 3: Competitiveness of domestic wheat compared to imports

		Cost in Ksh/90 Kg bag		
Imported	Landed price in Mombasa store		2,720	
	Landed price Nairobi (with 10% duty)		2,982	
	Landed price Nairobi without duty		2,758	
		Efficient	**Average**	**Least efficient**
Domestic	Landed price in Nairobi	1,696	2,053	2,445

Table 4: Simulations of the cost of production per acre using Kenya Ibis varieties

Items	**Efficient**	**Average**	**Least Efficient**
Yields (90 kg bag)/acre	20	20	20
Price per bag	2,800	2,800	2,800
Gross Output	**56,000**	**56,000**	**56,000**
Cost of Production/acre			
Machinery operation	5,400	4,200	4,200
Seed fertilizers and chemicals	12,180	11,380	9,180
Labor cost	1,060	920	815
Harvesting costs	2800	2600	2450
Return to Capital	1,577	1,385	1,211
Land rent	4000	4000	4000
Transport to Nairobi	120	150	150
Total production cost	**27,137**	**24,635**	**22,006**
Cost per bag	**1357**	**1232**	**1100**
Profit margin per bag	**1,443**	**1,568**	**1,700**

This variety was released in 2008 by Kenya Seed Company it is a variety tolerant to drought to stem rust and has good baking qualities The variety has an average potential of producing 20 bags per acre. There are also other newer varieties such as Farasi, and KS Chui also released in the same year by Kenya Seed in 2008. Simulation using Kenya Ibis varieties is summarized on Table 4. The cost per bag drastically reduces with an increase in the yields. The cost per bag reduces by 20%, 40% and 55% respectively for the efficient, average and least efficient farmers respectively. At this cost per bag all the three categories of farmers are competitive given the price of imported wheat landing Nairobi price is Ksh. 2,306. The replacement of the old varieties with new varieties may results in a decline in the costs of production.

Table 5: Mwea Irrigation Agricultural Development (MIAD) Development Guide per acre

Item	
Rice Yields (50 kg bags)	37
Price/bag	4,400
Gross output	**145,200**
Costs of production	
Land preparation	4,300
Seeds, Fertilizers and chemicals	13,410
Labor costs	18,950
Rent	25,000
Gunny bags	1,155
Transport from farm	1,650
Milling cost	3,300
Total cost	67,765
Overheads (10%) of total cost	6,777
Total cost of production per acre	**74,542**
Revenue per acre	**70,659**
Cost per bag	***2,015***
Revenue per bag	***1,910***

Source MIAD 2009

Table 6.Production cost in Ksh for milled NERICA rice in Kenya and Uganda

Item	**Kenya**	**Uganda**
Rice Yields (50 kg bags)	30	30
Price/bag	4,400	3,876
Gross Output	**132,000**	**116,280**
Production costs		
Seeds, Fertilizers and chemicals	10,200	7,752
Labor costs	16,900	13,886
Rent	3,000	1,550
Gunny bags	900	814
Transport from farm	900	1,163
Total cost per acre	***31,900***	***25,165***
Revenue per acre	***100,100***	***91,115***
Cost per bag	***1,063***	***839***
Revenue per bag	***3,337***	***3,037***