SOYBEAN SITUATION AND OUTLOOK ANALYSIS: THE CASE OF KENYA

Chianu Jonas N[1], Vanlauwe B[1], Mahasi, JM[2], Katungi E[3], Akech C[1], Mairura FS[1], Chianu Justina N[1], and Sanginga N[1]

[1]Tropical Soil Biology and Fertility institute of the International Centre for Tropical Agriculture (TSBF-CIAT), c/o World Agroforestry Centre (ICRAF), UN Avenue, Gigiri, P.O. Box 30677-00100 NAIROBI, Kenya;

[2]Kenya Agricultural Research Institute, Njoro, P.O. Box 57811-00200 NAIROBI, Kenya;

[3]CIAT-Africa, Kawanda, Uganda

April 2008

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ASMP	Agricultural Sector Management Project
LBDA	Lake Basin Development Authority

1. Introduction

Historians believe that soybean is one of the oldest crops raised by man. It was first grown in East Asia about 5000 years ago (BIDCO, 2005). This was approximately 5000 years after agriculture evolved. Soybean has been a staple crop in the diet of East Asians (especially China) for over 4000 years. It has a high commercial value and contains all the amino acids required by the human body except methionine, usually found in cereals such as maize (Osho, 1995). Of all grain legumes, soybean has the highest concentration of protein. While most other grain legumes contain about 20% protein by volume, soybean contains about 40% protein (Greenberg and Hartung, 1998). It is important to note that beef and fish contain about 18% protein. Soybean products are cholesterol free and high in calcium, phosphorus, and fiber (Greenberg and Hartung, 1998). Soybean provides more protein and low levels of saturated fat (BIDCO, 2005) than most other vegetable grains. As a major crop, the prominence of soybean in the western world was first experienced during the 1960s. Today, there are over 1000 varieties of soybean ranging in size from as small as a pea to as large as a grape. **Table 1** shows the high protein content of different parts or components of soybean (whole, hull, cotyledons, and hypocotyls).

Table 1: Nutrition content of different parts or components of soybean

Component	Protein (%)	Fat (%)	Carbohydrate (%)	Ash (%)
Whole	40	20	34	4.9
Hull	43	23	29	5.0
Cotyledons	8	1	86	4.3
Hypocotyls	41	11	43	4.4

Source: Osho, 1995

2. World soybean industry

Among the major oilseed crops in the world, soybean is the largest source of edible oils. The major U.S.A. oilseed crops are soybeans, cottonseed, sunflower-seed, canola, rapeseed, and peanuts. Soybeans are the dominant oilseeds in the United States America, accounting for about 90% of U.S. oilseed production (USDA, 2008). Between October

1999 and September 2000, global production of the main oilseeds rose by about 5 million tons to reach approximately 310 million tons with soybeans accounting for between 170 and 180 million tons, or about 55% of the global output. During the last decade, the production of soybean grew at the rate of 5.4% at the global level with growth rates during 1997, 1998 and 2001 stabilizing at 11% per annum.

According to recent FAO statistics, total world production of soybean increased from 136.5 million MT in 1994 to 189.2 million MT in 2003. Major global producers in order of importance include the United States of America, Brazil, Argentina, and Bolivia. The 10 largest soybean producers in the world (USA, Brazil, Argentina, China, India, Paraguay, Canada, Bolivia, Indonesia, and Nigeria) together produced about 185 million MT in 2003 (approximately 98% of total world production). In 2003, about 190.1 million MT of soybean (representing 56% of world production of oilseed) was produced in the world. World soybean trade (in terms of imports and exports) is a big business amounting to nearly US$11 billion in 2002.

Soybean growers in leading producing countries (especially Brazil, Argentina, and the U.S.A) have been using biotechnological innovations to boost soybean production. As a result, most of the soybean that is currently grown has undergone biotech modification (Jagwe and Nyapendi, 2004). Based on the 2003 production records, about 81% of the soybean produced in the United States of America has been modified using biotechnology while Argentina and Brazil have genetically modified 99% and 34% of their respective soybeans (Jagwe and Nyapendi, 2004 citing American Soybean Association, 2004). The use of biotechnology modified planting materials confers the advantages of higher crop yields and greater tolerance to soybean diseases and pests (Jagwe and Nyapendi, 2004). High crop yield increases the profits that farmers make from soybean production and marketing enterprises. **Table 2** shows the international soybean quality specifications preferred in the world market.

Table 2: Quality specifications for soybean in the world market

Characteristic	% Minimum	% Maximum	% Basis
	Test weight: 54 lbs/bu		
Protein	35		
Oil content	18		
Moisture content		14.0	
Splits		20.0	
Foreign matters		2.0	
Soybean other color		2.0	
Heat damaged kernel		0.5	
Total damaged kernel		3.0	
Oil content			18.0

Source: Adapted from Jagwe and Nyapendi, 2004

3. Soybean production in Africa

Compared to the USA, South/Latin America and Asia, Africa is a very small producer of soybean. During the last decade or so, Africa accounted for 0.4 – 1% of total world production of soybean. The main producers within the continent include Nigeria, South Africa, Uganda, and Zimbabwe. Nigeria, which contributed nearly 50% of Africa’s output, accounted for a mere 0.3% of the world soybean output in 2003.

About 19 African countries are recorded in the world soybean production statistics compiled by FAO. These countries and the proportion (%) of African soybean production that each accounts for are: Nigeria (48.9%), Uganda (16.8%), South Africa (14.9%), Zimbabwe (8.4%), Ethiopia (2.7%), Rwanda (2.0%), Egypt (1.7%), and DRC (1.4%). Others are: Cameroon (0.8%), Benin (0.7%), Cote d’Ivoire (0.3%), Liberia (0.3%), Burkina Faso (0.3%), Zambia (0.2%), Gabon (0.2%), Tanzania (0.2%), Morocco (0.1%). Kenya is a very small soybean producer, even within the African context. Earlier FAO records did not recognise Kenyan production in global soybean statistics. Historic data on Kenya’s soybean production is poorly collected and lacking, especially in the years before 1990. After 1990, data suggests that production, area and yield have remained almost stagnant, with little annual change (FAOSTAT, 2008). Table 3 shows the key soybean producing districts from different provinces in Kenya

Table 3: Main soybean production districts in Kenya

Province	Districts
Western	Busia, Bungoma, Teso, Butere/Mumias, Kakamega, Mount Elgon, Lugari, Vihiga
Rift valley	Nakuru, Nandi, Trans Nzoia, Koibatek, Narok, Trans, Mara, Laikipia, Bomet
Eastern	Meru, Embu, Mbeere, Machakos
Nyanza	Rachuonyo, Homabay, Gucha, Kisii, Nyamira, Siaya
Central	Kirinyaga, Murang'a, Maragwa, Nyeri

Western province stands out as the leading soybean producing province in Kenya, accounting for nearly 50% of total national smallholder planted area and production in 2003. The main soybean producing districts in Western province are Butere/Mumias, Busia, Bungoma, Teso, Kakamega, Mount Elgon, Lugari, and Vihiga. Butere/Mumias, Busia, and Bungoma districts accounted for approximately 80% of the total soybean production in the Western province of Kenya in 2003. Other major soybean producing provinces in Kenya after the Western province are Nyanza and Central provinces, which accounted for 11-12% of total smallholder soybean production in 2003.

Estimates of area potentially suitable for soybean production ranges from 157,000 ha (estimated by the Ministry of Agriculture in 1995) to 224,000 ha (more recently estimated by the Lake Victoria Basin Development Authority). While Nyanza province accounts for 11–15% of Kenyan land area potentially suitable to soybean cultivation, the Western province accounts for 9–13%. At district level, Uasin Gishu, Trans Nzoia, Siaya, and Bungoma districts account for the largest proportion of land potentially good for soybean production in Kenya.

4. Role of soybean in Kenyan economy

As a legume, soybean improves soil fertility by fixing atmospheric nitrogen (one of the plant nutrients lacking in most of Kenya's soils) into the soils and this is another strong reason why the adoption of the improved varieties of soybean such as the TGx series from the International Institute of Tropical Agriculture (IITA) that also leads to increase in yield should be promoted. Soybean also presents the farmers with the much needed alternative cash income source. For the other important benefits of soybean in the farming systems of Kenya and elsewhere (Chianu and Vanlauwe 2006). In the Economic Recovery Strategy (ERS) for wealth creation and employment creation, the Kenyan government identified agriculture as an important vehicle for the realization of its employment creation and poverty reduction objectives. According to this strategy, the government's vision is to transform Kenya's agricultural sector into a profitable economy (Government of Kenya, 2004). This transformation calls for fundamental shift to market-oriented production, diversification of agriculture such as soybean and adoption of greater use of appropriate farming practices. Soybean is one such crop that has the potential to make significant contributions to healthcare (Government of Kenya, 2002; Ohiokpehai and Osborne, 2003), income and livelihood security.

5. Soybean production by small and medium/large scale farmers in Kenya

In Kenya, smallholder (usually non-commercial) farmers (with land holding ranging from 0.1 to 0.2 ha) almost wholly undertake soybean cultivation. Information on the involvement of large-scale farms in soybean production in Kenya is rather scanty. Sub-sector observers indicate that about seven large-scale farm enterprises in different parts of Kenya occasionally cultivate soybean. The quantity of soybean produced by these large holders is not precisely known but is estimated at about 4 000 MT per annum. The large-scale operators include: Hugo Wood (located in Narok), George Nightgale farm (Njoro), Menengai Feedlot (Njoro), Timau soybean production (Meru), Kisima farm (registered seed merchant, Meru), Rumuruti Kisima (Laikipia district), Hortitec Seed Company (Naivasha), Delamere Estates (Naivasha), Elkana Owgeas, Western Seed Company (Kitale), Mwea irrigation scheme managed by National Irrigation Board (Kirinyaga district), and KARI (Njoro). Some of these medium to large scale farms have sporadically planted soybean either for own use or for sale. Record shows that: (i) *Hugo Wood* (Narok) purchased soybean seed from KARI in 2002, (ii) *Nightingale farm*/Menengai Feedlot (Njoro) planted 50 acres of soybeans in 2003, and (iii) *Kisima farms* (Meru) planted 50 acres of soybeans in 2001/2002.

6. Soybean production, area and yield in Kenya

Nationally, FAO (2008) (**Table 4**) data estimates an average yield of 800 kg ha^{-1} of soybean which has been stagnant since 1990. However, there is regional variability in yield. Between 1999 and 2003, soybean annual average yield ranged from 560 kg ha^{-1} (Western province) to 1100 kg ha^{-1} (Eastern province). The average yields obtained in Rift Valley and Central provinces ranged in between these figures. It has, however, been demonstrated that it is possible to obtain soybean yields of 3000 –3600 kg ha^{-1} from improved varieties of soybean and with good management practices (Teresio Riungu, personal communication). According to the 2003 data, the highest farm-level soybean yield (of 1600 kg ha^{-1}) in Western province was obtained from *Butere/Mumias* district. Depending on agro-ecology, the expected yields from the six different soybean varieties (out of the 300 lines evaluated) recommended from the work of GTZ SBP project (1993 - 1998) ranges from 0.6 to 1.9 t ha^{-1} (**Table 4**). Of these six varieties, a survey carried out in 1998 indicates that *Nyala*, Gazelle, and Duicker appear to be the most widespread, most probably due to seed availability, rather than the choice of farmers (Kaara *et al.*, 1998).

Table 4: Soybean area, yield and production in Kenya: 1990-2007

Year	Area (ha)	Yield (kg ha^{-1})	Production (tons)
1990	2500	800	2000
1991	2500	800	2000
1992	2500	800	2000
1993	2500	800	2000
1994	2500	800	2000
1995	2500	800	2000
1996	2500	800	2000
1997	2500	800	2000
1998	2500	800	2000
1999	2500	800	2000
2000	2500	800	2000
2001	2500	800	2000
2002	2500	800	2000
2003	2500	800	2000
2004	2500	800	2000
2005	2500	800	2000
2006	2513	826.5	2077
2007	2500	840	2100

Source: FAO, 2008.

Table 5: Expected yields of soybean varieties recommended (for various areas of Kenya) from GTZ project in Kenya (1998)

Climatic description	Area	AEZ	Variety	Expected yield (t/ha)
Warm temperatures	Homa Bay Mitunguu	LM3 LM3	Duiker, EAI3600, Nyala	1.2 to 1.6
Moderate temperatures	Bukura Kakamega Kitale Embu	LM1 UM1 UM4 UM3	SCS1, Duiker, Nyala, Gazelle	1.4 to 1.9
Cool temperatures	Bahati Baraton Njoro Menengai	LH2 LH2 LH3 LH3	Sable, SCS1, Nyala, Gazelle	1.2 to 1.5
Marginal rainfall sites	Matayos Gachoka Makuyu Ol Rongai	LM2 LM3 UM4 LH4	Gazelle, EAI3600, Nyala, Sable	0.6 to 1.0 (to 1.6)

Source: Krause and Wasike, 1998

7. Soybean utilization

7.1 Global utilization of soybean

Globally, soybean has a wide range of edible and industrial uses which are broadly categorized as:

(i) Soybean oil products for both human consumption and industrial uses (including refined oil products, glycerol fatty acids and sterols),

(ii) Soybean protein_products (including flours, concentrates, isolates for edible and industrial uses, and soybean meal for animal feeds), and

(iii) Whole-soybean products for human consumption. Soybean is also used for animal feeds as soybean meal (from residues after extracting oil mainly for poultry and livestock).

In the United States of America, soybean provided 80% of the edible fats and oils in 2003. The domestic crush level was about 40 million metric tons. However, it is important to note that soybean contains the trypsin inhibitor, which makes it impossible for human beings- and other non ruminants- to digest it once consumed. To destroy the inhibitors, soybean must be heat-treated (balanced) during processing.

7.2 Soybean utilization and consumption in Kenya

Kenya consumes about 400 000 MT of vegetable oils and local production only meets a third of this demand (Jagwe and Nyapendi, 2004). Oil palms, sunflower and soybeans are vital sources of vegetable oils in Kenya. Coupled with increasing demand for soybean cake for animal feeds manufacturing, Kenya can easily absorb up to 150 000 MT of soybean in raw form annually (Jagwe and Nyapendi, 2004). Industrial uses of soybean such as in the manufacture of anti-corrosion agents, core oils, bio fuel, disinfectants, pesticides/fungicides, printing inks, paints, adhesives, antibiotics, and cosmetics among others is still not widespread in Kenya.

In Kenya, if human consumption accounts for 10-15% (or 10 000 - 15 000 MT) per annum and domestic production still stands at 1 000 to 5 000 MT, it means that a part of the domestic human demand for soybean is currently being fulfilled through soybean import. The estimated national production, around 2000 MT (FAO, 2008) has been mostly stagnant across the years. This indicates the existence of scope to further increase domestic production of soybean to satisfy domestic human demand. It is therefore surprising that farmers in Kenya, who are yet to satisfy the domestic human demand, are complaining of lack of market for soybean. Meanwhile, demand by the human consumption market segment (in Kenya) is expected to rise to about 150 000 MT per year over the next ten years (Jagwe and Nyapendi, 2004).

With insignificant quantities from local smallholder producers getting through to the industrial and livestock feed processors, it can safely be assumed that Kenyans consume (in various forms), at household level, the entire national annual output of soybean produced by the farmers. The proportion of soybean imported (from Uganda, the DR-Congo, and Rwanda) that goes into household-level consumption is not known. In any case, key sub-sector observers such as BIDCO, Soya Afric, and ALBH feel that household consumption accounts for less than 1% of total national human consumption of soybean in Kenya. Data on domestic consumption of soybean oil is also not readily available. However, BIDCO/Elianto, the main oil processors, produces about 500 MT of soybean oil per year. BIDCO, followed by Proctor and Allan, is the main buyer of soybean grains in Kenya. **Figure 1** show estimates of soybean and soybean oil consumption in Kenya. Consumption of soybean oil using FAO data showed a low rate of utilization up to 1990s, after which it increased annually. Average consumption of soybean oil tended to increase with each decade after 1961 (from 600 MT- 4000 MT), while soybean consumption increased dramatically after 1990, averaging 1670 MT. Soybean oil consumption has been more widespread and has been growing faster than soybean grain consumption. FAO estimates that of the total soybean oil and grains consumed between 1961 and 2003, over 65% (computed by the authors) was consumed after 1990, while over 70% of the soybean oil was consumed after 1990.

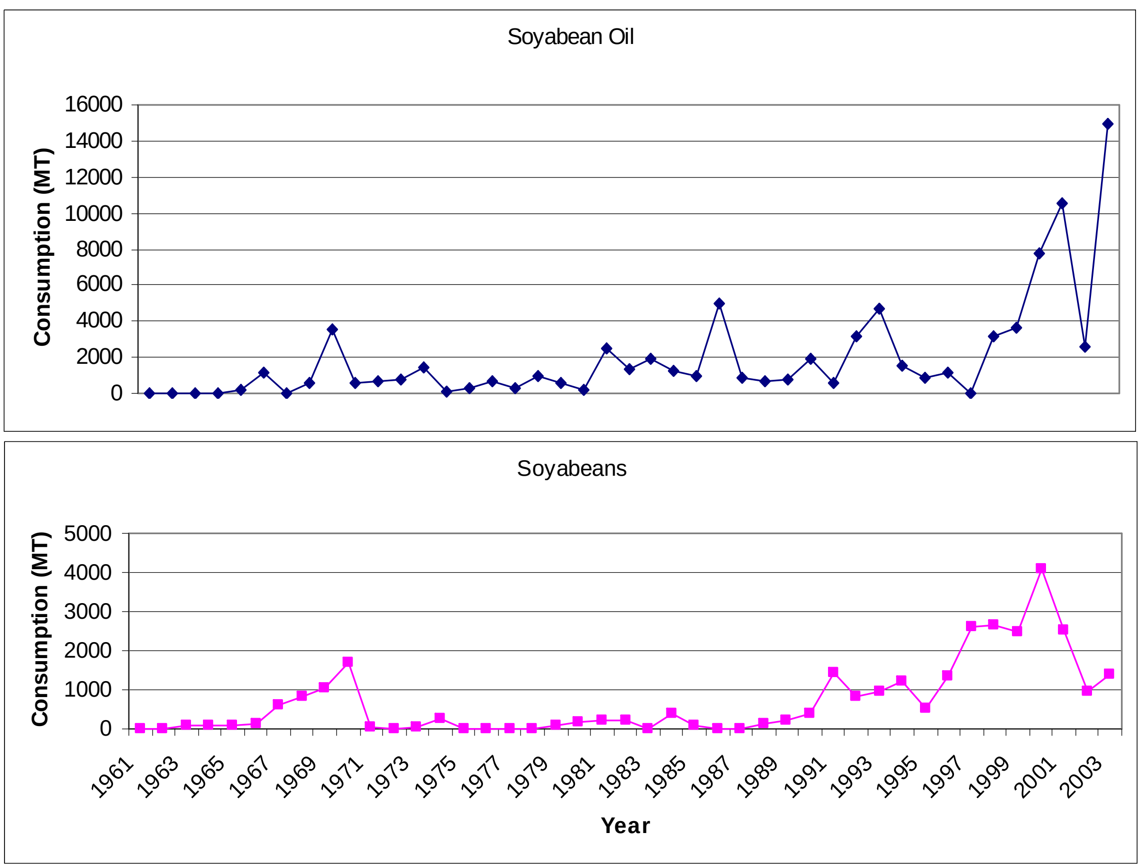


Figure 1: Soybean consumption (Ton) in Kenya (1961-2003)

Consumption has been showing a highly variable pattern (Figure 2), but the general long-term trend showed an increased consumption after 1990s. Of the total cumulative soybean oil (more than 84,000 MT) and soybean (more than 29,000 MT) consumption since 1961 to 2003, over 65% of the soybean oil was consumed after 1990, with over 70% of the oil being consumed in the same period.

7.3 Household level utilization

Despite having been grown in Kenya for about one century, soybean utilization at household level is still low. The major reasons that have attributed to this are:

(i) The laborious method of heat treatment, which is not only time consuming, but also expensive in terms of cooking fuel used.

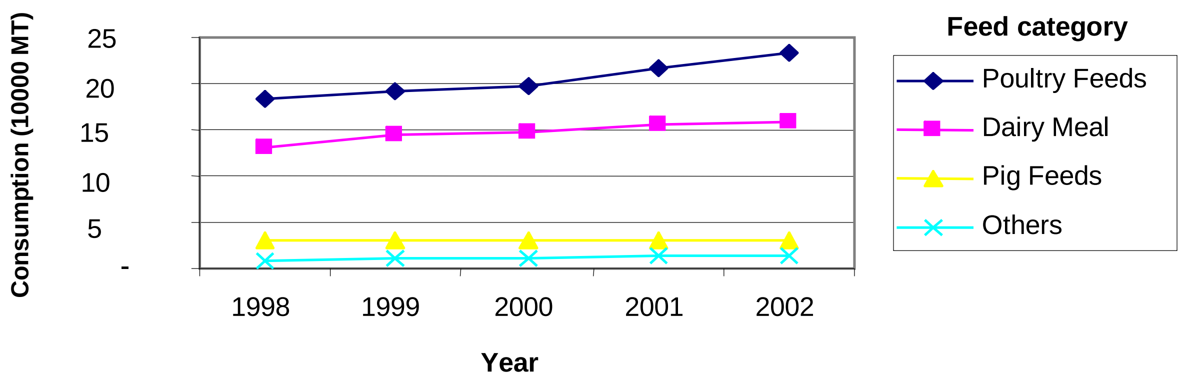
(ii) Lack of sufficient knowledge in the preparation of soybean.

(iii) Lack of broad-based awareness of the nutritional value of soybean due to insufficient promotion.

As a consequence, soybean has never become part of the traditional diet among Kenyans. Because of the low popularity of the commodity arising from the aforementioned factors, it has tended to be a slow moving food item compared to other pulses and hence having a backlash effect in terms of growth in production.

7.4 Livestock feed consumption

This constitutes the largest market for soybean in Kenya, accounting for approximately 90% of all soybean utilization in the country. According to the Farmers' Own Trading Ltd (FOTL), close to 60% of all livestock feeds produced in Kenya is compounded with soybean. The main uses of soybean in livestock feed manufacture include dairy meal, poultry feeds, and pig feeds. The number of livestock feed industries in Kenya is well over 80, most of which are located in Nairobi, Nakuru and Thika. The total annual consumption of soybean by these industries increased from approximately 354 000 MT in 1998 to about 437 000 MT in 2002. This market is largely dependent on imports (because of lack of supplies from local sources). According to FOTL, based on data from the Ministry of Livestock and Fisheries, national livestock feeds consumption grew at an average rate of 5.3% per annum between 1998 and 2002. As shown in **Figure 2**, poultry feed uses are by far the largest consumer, showing rapid increases since 2000. The dairy feed uses of soybean follow poultry soybean consumption in Kenya, while pig feeds are minor livestock sectors that consume soybean.



Source: Farmers' Own Trading Company-based on statistics from the Ministry of Livestock and Fisheries

Figure 2:.Livestock feed uses and consumption trend in Kenya: 1998-2002

7.5 Institutional consumer markets

The institutional demand for soybean and soybean-related products is mainly for making porridge, for mixing with other flour products, and as food supplements (e.g. unimix) for relief food used in feeding refugees. Although this demand is significant, it fluctuates from time to time. On the basis of the current supplies to relief agencies and other uses such as making porridge, Unimix and for mixing with other flour products (Kaara *et al.*, 1998). FOTL/ABLH (2004) estimated total consumption by this market segment in Kenya at about 10 000 MT per year (or approximately 10% of total annual domestic requirements for soybean and related products.

8. Soybean processing in Kenya

Soybean processing in Kenya is mainly comprised of two levels: the industrial level and the artisanal or cottage level. These are described in the sections below.

8.1 Industrial level soybean processing in Kenya

This is the largest and most dynamic channel, accounting for nearly 99% of the total processed volume of soybean and related products. In Kenya, there are over 30 processing units engaged in processing different oilseeds, oil-bearing materials and vegetable oils (oil milling, solvent extraction, refining and hydrogenation). The installed oil extracting capacity is about 265,000 MT/year. About 342,000 MT/year refining capacity is available mainly to process imported crude palm oil. While oil extraction units were established mostly during the expansion of oilseed crops in Kenya, the refining capacity has been created with the increased dependence on imports and especially the processing of palm oil. The structure of the import tax policies (the sub-sector is faced with 5% for oil seeds, 15% for crude oil, and 25% for refined oil) coupled with then low international prices of edible oils rendered the oil milling, solvent extraction and refining of domestic oils uneconomical and their capacity is grossly underutilized. Lack of adequate crushing margins compelled closure of some mills while others are operated at far below capacity leading to the reduction of demand for oilseeds. Utilization of some of the processors is currently as low as 15% of their installed capacity.

Industrial soybean processing almost entirely depends on imports of raw materials. The livestock feed millers have more than 80 actors. Nairobi, Thika, and Nakuru are key concentration areas for the livestock feed millers. Three distinct soybean-processing technologies with similar end products can be identified in Kenya (**Table 6**).

Table 6: Main soybean processing technologies in Kenya

Technology	Processes	Main soybean product	Uses
Solvent extraction	Chemical processes to separate cake & oil.	Cake Oil	Livestock feed processors Industrial crude oil users Industrial refined oil users
Expeller	Through heating process to separate cake and oil.	Cake Oil	Animal feed processors Industrial crude oil users Industrial refined oil users
Extruders	Through cooking for separation	Whole meal/Full Fat	Human consumption (Unimix e.g., maize/soy flour (20:80) Pet feed users

The solvent extraction and expeller technologies produce the same product. The fundamental difference is in terms of efficiency of oil extraction. While the solvent extraction will give an oil residue of around 2% in the cake, the expeller will give a residue rate of 6–10%. A processing plant imported into Kenya about 10 years ago is yet to be commissioned. It is also said to be lying at the port in Mombasa. The type of end product and the market focus can be used to categorize the industrial processors. Possible categories are as follows:

(i) Protein cake and edible oil processors

These process many oil crops (soybean, sunflower, cotton, etc). Examples include BIDCO and Rift Valley Products (both are in Nakuru). Each requires about 10 000 tons of soybean annually. BIDCO mainly import their soybean requirements while Rift Valley Products recently stopped utilising soybean, sighting the high price of soybean grain (comparison to sunflower and cotton).

(ii) Human food processors

These include Proctor and Allan, House of Manji (Global Allied Industries), Soya Afric; INSTA Products, Wonder Foods, etc. The main product generated by these processors is Unimix most commonly sold to the World Food Programme.

8.2 Artisanal/cottage-level soybean processing in Kenya

Cottage processing is used at the household and micro-business levels. The players at this level are farmers and small-scale entrepreneurs. Some artisanal processors use simple household equipment such as the hand grinder, pestle and mortar, and roasting pans. Others take the roasted soybean to maize millers and pay for grinding services. Yet others such as the Busia Farmers Training Centre (BFTC) use a prototype soybean-grinding machine developed by KIRDI. Artisanal processing in Kenya has been much more prevalent in Kisii and Trans Nzoia districts with a much larger population of of the Seventh Day Adventists (SDA) church loyalists that prefer soybean drinks to most of the alternative beverages. At the artisanal level, processing operations are usually laborious and expensive (in cooking fuel and human time). Although the number of actors at this level is large, the exact size is not precisely known. The capacity of artisanal processing is small with key sub-sector observers estimating it at 1–2% of total volume consumed domestically.

Processing technology that has been introduced under all past sub-sector development initiatives has never gone beyond household artisanal/cottage level. Frying for consumption as snacks within the household; treatment through boiling, drying in the sun and grinding to make flour which is mixed with other products flour to make various recipes such as *chapati*, *mandazi* and other consumer products (GTZ, 1996). There is however some limited presence of cottage level processing technology using simple power-driven machines, such as one recently fabricated KIRDI and found at Farmers Training College in Busia Town. What is missing in soybean processing technology is a commercially viable technological package for processing that is adaptable to medium to small and micro enterprise sized businesses. Yet it is said by key sub-sector informants that this level of technology is available in Japan, China and India.

9. International trade

9.1 Global soybean exports and imports

Over the past decade, the United States of America has maintained the lead and dominance in world soybean production and trade and has remained the world's largest total exporter of soybeans and soybean products. The U.S. supplied about 40% of the soybean traded in the world soybean market. The U.S. soybean and soybean related products export attracted US$ 9.7 billion in 2003. Between 1995 and 2002, the world soybean export volume (MT) has been on the increase. However, the value of soybean exports has been more or less stagnant due to the steadily falling world price of the commodity. Most of the soybean cultivated in the USA is processed into soybean oil, used widely in vegetable oils, shortenings and margarines, and high-protein animal feeds.

China is the largest consumer of U.S. soybean, with annual imports totaling US$2.9 billion. The European Union follows Chinese consumption with annual purchases of about US$1.1 billion. Other significant global importers of US soybean include Mexico

(US$981 million) and Japan (US$957 million). Regarding global soybean meal export trends, Brazil has remained a leading exporter, although Argentina is narrowing the gap with Brazil (Jagwe and Nyapendi, 2004). However, with respect to U.S. soybean meal, Canada is the leading importer, obtaining annual soybean meal worth US$242 million. The other major U.S. soybean meal consumer countries included Mexico (US$150 million), and Indonesia (US$96 million). Soybean oil export and consumption trends globally have been dominated by the US and Latin American countries. Argentina has remained as the world's largest exporter of soybean oil over the past decade. Annual growth in US soybean oil exports exceeded Brazil as the second largest net exporter of soybean oil (Jagwe and Nyapendi, 2004). With respect to the purchases of the U.S. soybean oil, Mexico was the major consumer with annual imports worth US$82 million in 2003. Canada imported soybean oil worth US$72 million over the same period.

9.2 Soybean imports and exports in Kenya

As provided in the CBS (Central Bureau of Statistics) statistical abstract (2003), the volume of imports of vegetable oil and fats in 2002 was estimated at approximately 390,000 MT having increased dramatically from about 250 000 MT in 2000. The current requirements for soybean and soybean-related products (mainly soybean meal and soybean cake) are in the range of 70,000–100,000 MT (18-26% of the vegetable oils is obtained soybean oil) as compared to between 1,000 and 5,000 MT produced locally by farmers. Assuming that soybean grain translates to oil on one-to-one basis, this implies average deficits (domestic production compared with domestic need) in the order of 96% of total requirements for soybean oil that the country has to import. FOTL estimates the deficits at about 90%.

Overall, total soybean imports (all products) in Kenya have been more than exports since 1961. The total import and export soybean business increased significantly since 1990. Over 69% and 97% (imports and exports) of total soybean product value transacted since 1961 was traded after 1990 **(Table 7, Table 8, Figure 3, Figure 6, and Figure 7).** From 1991 to 2006, the total import value was more than USD180 000, while exports were slightly above 50 000 USD **(Figure 8).** Import activity picked momentum earlier than exports, partly because soybean capacity had not yet developed. Among imports and exports, soybean oil was the most important item, accounting for up to 80% of the cumulative trade volume (1961-2006). Recent official disaggregated data on imports and exports are not yet available, but a more or less recent study by FOTL/ABLH (2004) indicated that India was the main source of soybean meal imported into Kenya, accounting for approximately 85% of total imports in 2002 at an average CIF cost (Mombasa) of KShs 22.40 kg^{-1}. Other sources of imports (mainly whole soybean) include Uganda, Rwanda and the DR Congo. According to the FOTL study, imports of soybean meal and soybean flour was approximately 110 000 MT (valued at KShs 4 billion) in 2001 and 87,000 MT (valued at KShs 3 billion) in 2002.

The demand for domestic exports, mainly in the form of food supplements, is dependent on relief food requirements, with the volume varying from time to time. There is no reliable data on exports either, but based on data from FAO, Kenya's exports of soybean and related products have been minimal in the recent past (estimated at 2, 040 MT in 1997 and at 500 MT in 1998). No statistical estimates are provided for the years after 1997. The main export destinations have been Uganda, the DR Congo, the Sudan and Malawi.

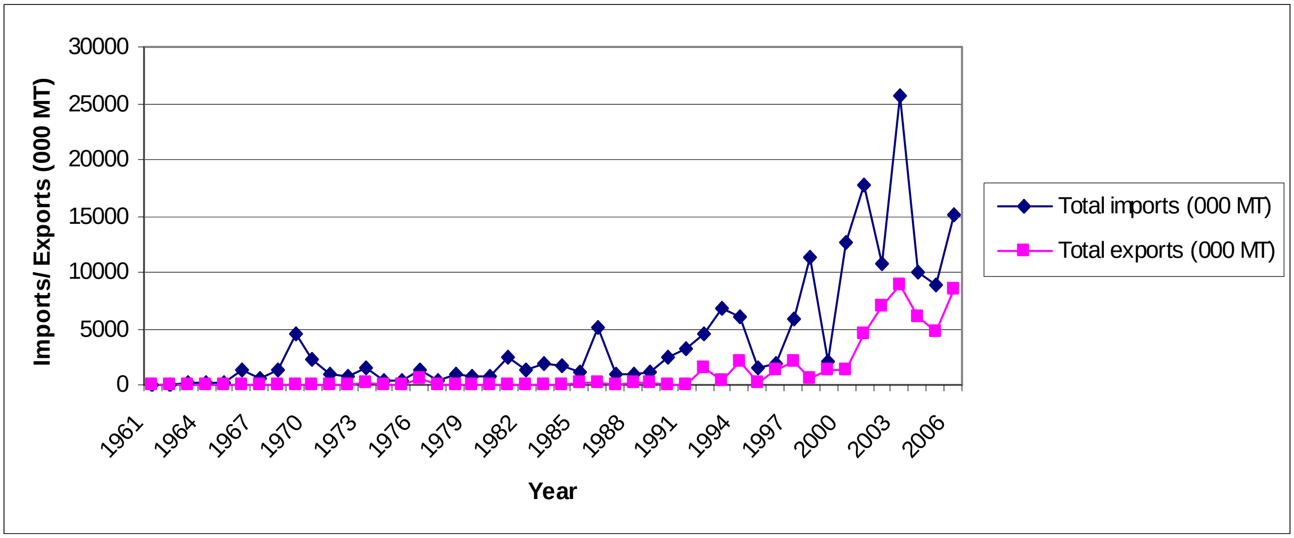


Figure 3: Total imports and exports for all soybean products per year (000 MT) in Kenya (1961- 2006)

Table 7: Soybean import and export quantity (000 MT)

Year	Import quantity			Export quantity			Total imports (000 MT)	Total exports (000 MT)
	Soya Sauce	Soybean oil	Soybeans	Soya Sauce	Soybean oil	Soybeans		
1961	0	26	0	0	0	0	**26**	**0**
1962	0	2	0	0	0	0	**2**	**0**
1963	0	8	88	0	0	0	**96**	**0**
1964	0	0	97	0	0	0	**97**	**0**
1965	0	149	119	0	0	32	**268**	**32**
1966	0	1181	120	0	0	0	**1301**	**0**
1967	0	6	641	0	0	25	**647**	**25**
1968	0	537	840	0	0	0	**1377**	**0**
1969	0	3577	1035	0	0	0	**4612**	**0**
1970	0	604	1705	0	0	0	**2309**	**0**
1971	0	700	165	0	0	0	**865**	**0**
1972	0	805	0	0	0	0	**805**	**0**
1973	0	1413	120	0	0	180	**1533**	**180**
1974	0	109	247	0	0	0	**356**	**0**
1975	0	307	0	0	0	0	**307**	**0**
1976	0	1284	0	0	659	0	**1284**	**659**
1977	0	313	0	0	0	0	**313**	**0**
1978	0	929	0	0	0	0	**929**	**0**
1979	0	575	107	0	0	0	**682**	**0**
1980	0	211	572	0	0	0	**783**	**0**
1981	0	2503	1	0	0	5	**2504**	**5**
1982	0	1369	0	0	0	2	**1369**	**2**
1983	0	1919	2	0	0	0	**1921**	**0**
1984	0	1245	400	0	0	0	**1645**	**0**
1985	0	949	211	0	0	140	**1160**	**140**
1986	0	5082	0	0	127	0	**5082**	**127**
1987	0	886	1	0	4	0	**887**	**4**
1988	0	625	239	0	0	114	**864**	**114**
1989	0	899	239	0	109	0	**1138**	**109**
1990	3	1986	370	0	76	0	**2359**	**76**
1991	9	579	2683	1	23	50	**3271**	**74**
1992	5	3278	1254	6	90	1434	**4537**	**1530**
1993	16	4890	1914	3	172	244	**6820**	**419**
1994	57	3687	2247	28	1541	526	**5991**	**2095**
1995	52	1515	8	1	259	0	**1575**	**260**
1996	56	1012	833	0	826	421	**1901**	**1247**
1997	68	135	5647	0	100	2040	**5850**	**2140**
1998	63	6159	5119	0	33	486	**11341**	**519**
1999	77	1986	2	0	1335	45	**2065**	**1380**
2000	90	9054	3552	0	1246	0	**12696**	**1246**
2001	152	14386	3137	3	3801	671	**17675**	**4475**
2002	87	9051	1528	6	6457	585	**10666**	**7048**
2003	104	22971	2645	11	7609	1296	**25720**	**8916**
2004	28	4929	4963	0	5202	788	**9920**	**5990**
2005	120	3523	5147	12	3798	916	**8790**	**4726**
2006	103	6648	8261	0	2135	6315	**15012**	**8450**

Source; FAO 2008

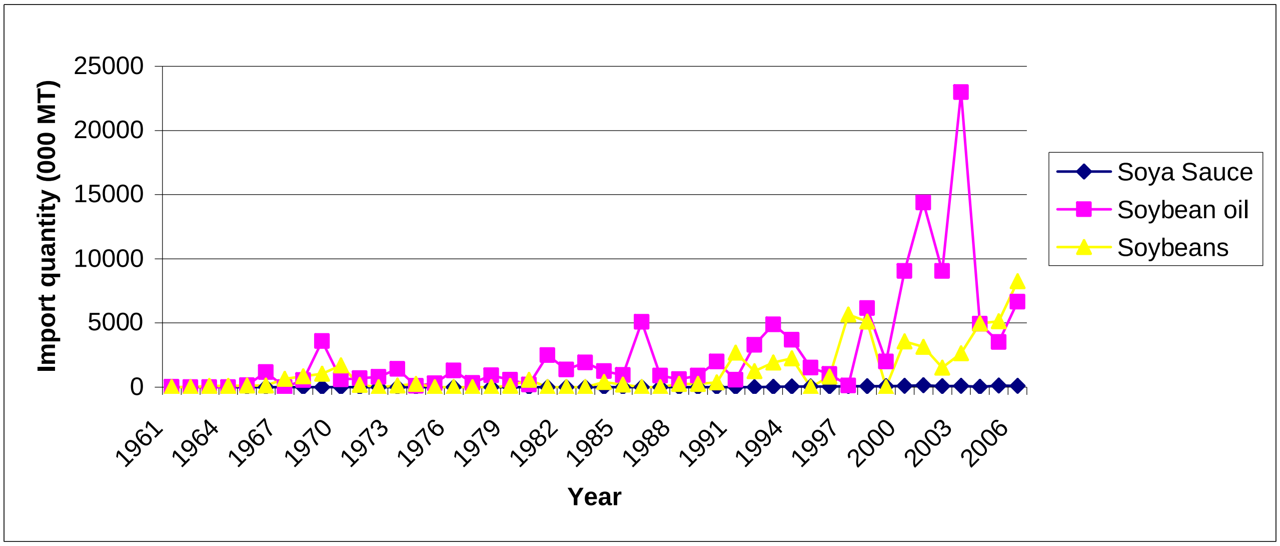


Figure 4: Total imports (000 MT) of soya sauce, soybean oil, and soybean grains in Kenya (1961- 2006) [Source: FAO 2008]

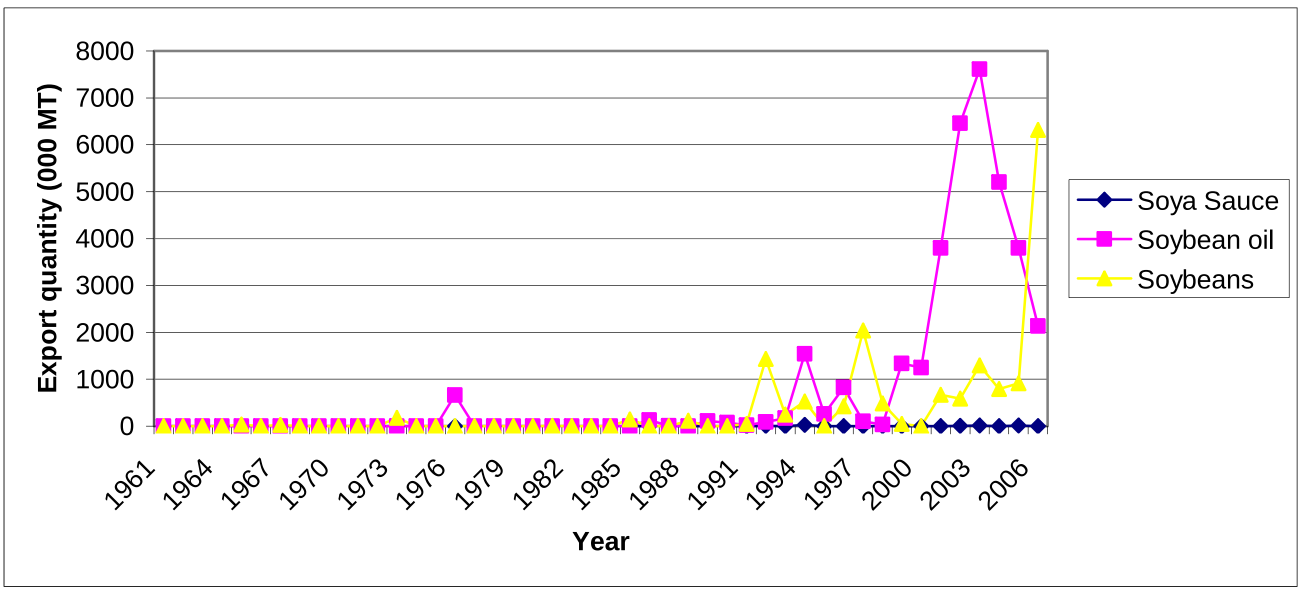


Figure 5: Total exports (000 MT) in Kenya (1961- 2006) [Source; FAO 2008]

Table 8: Estimated soybean imports and export value (000$) in Kenya (1961- 2005)

	Imports			Exports			Total	
Year	Soya Sauce	Soybean oil	Soybeans	Soya Sauce	Soybean oil	Soybeans	Imports	Exports
1961	0	10	0	0	0	0	**10**	**0**
1962	0	1	0	0	0	0	**1**	**0**
1963	0	2	6	0	0	0	**8**	**0**
1964	0	0	7	0	0	0	**7**	**0**
1965	0	80	11	0	0	3	**91**	**3**
1966	0	680	12	0	0	0	**692**	**0**
1967	0	3	64	0	0	4	**67**	**4**
1968	0	181	73	0	0	0	**254**	**0**
1969	0	886	94	0	0	0	**980**	**0**
1970	0	271	173	0	0	0	**444**	**0**
1971	0	362	20	0	0	0	**382**	**0**
1972	0	326	0	0	0	0	**326**	**0**
1973	0	545	34	0	0	24	**579**	**24**
1974	0	72	71	0	0	0	**143**	**0**
1975	0	354	0	0	0	0	**354**	**0**
1976	0	939	0	0	591	0	**939**	**591**
1977	0	293	0	0	0	0	**293**	**0**
1978	0	881	0	0	0	0	**881**	**0**
1979	0	628	130	0	0	0	**758**	**0**
1980	0	580	620	0	0	0	**1200**	**0**
1981	0	2638	3	0	0	2	**2641**	**2**
1982	0	1306	0	0	0	1	**1306**	**1**
1983	0	1999	1	0	0	0	**2000**	**0**
1984	0	1384	227	0	0	0	**1611**	**0**
1985	0	1285	151	0	0	63	**1436**	**63**
1986	0	4292	0	0	148	0	**4292**	**148**
1987	0	3196	1	0	6	0	**3197**	**6**
1988	0	501	60	0	0	21	**561**	**21**
1989	0	283	52	0	76	0	**335**	**76**
1990	1	1376	60	0	68	0	**1437**	**68**
1991	6	467	572	4	25	23	**1045**	**52**
1992	2	2280	320	10	64	289	**2602**	**363**
1993	16	3355	501	11	128	282	**3872**	**421**
1994	24	2470	741	22	924	197	**3235**	**1143**
1995	32	1359	5	1	310	1	**1396**	**312**
1996	37	1106	452	1	896	186	**1595**	**1083**
1997	69	114	2090	0	120	5260	**2273**	**5380**
1998	80	4841	2431	0	23	388	**7352**	**411**
1999	101	1233	1	0	1250	22	**1335**	**1272**
2000	173	3287	956	0	918	0	**4416**	**918**
2001	92	5346	508	5	2181	231	**5946**	**2417**
2002	48	3880	188	4	5145	167	**4116**	**5316**
2003	92	12893	301	3	9559	431	**13286**	**9993**
2004	23	2659	1801	1	4553	414	**4483**	**4968**
2005	141	2277	336	0	5061	414	**2754**	**5475**

Source; FAO 2008

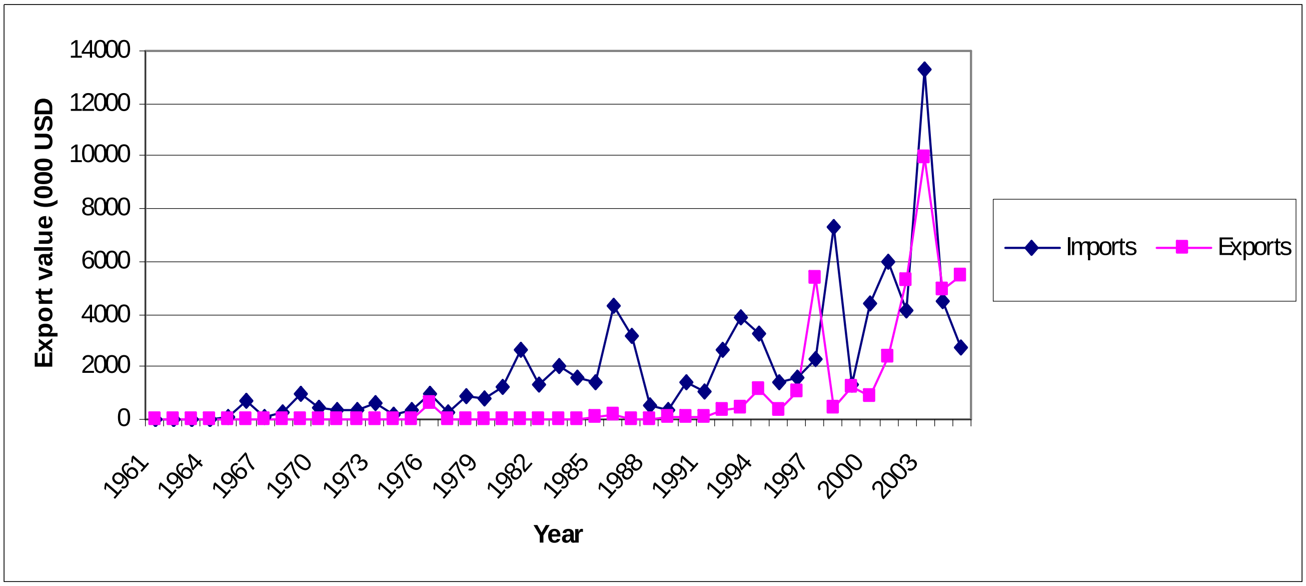


Figure 6: Total soybean imports and export value (000$) in Kenya (1961- 2005) Source: FAO 2008]

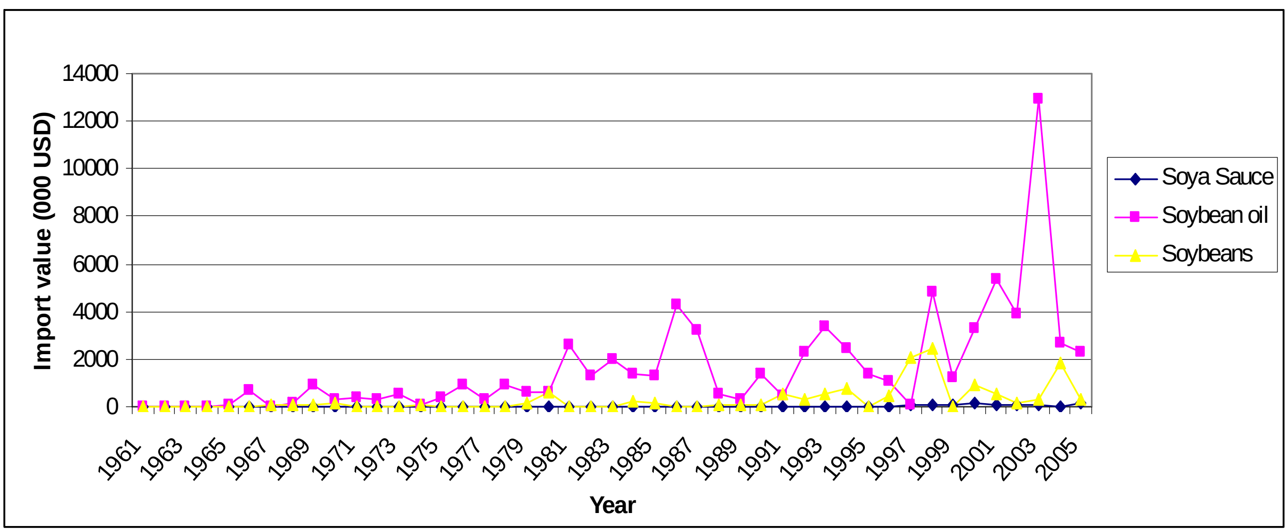


Figure 7: Estimated soybean imports value (000$) in Kenya (1961- 2005) [Source: FAO 2008]

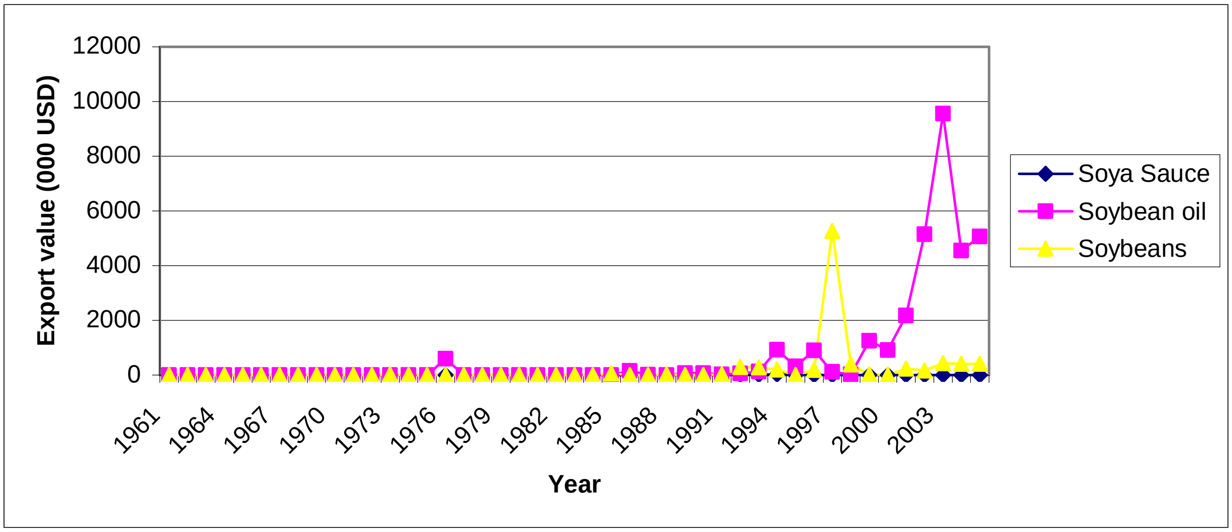


Figure 8: Estimated soybean export value (000$) in Kenya (1961- 2005) Source; FAO 2008

10. Soybean international and local prices

The world soybean prices are mainly influenced by the Rotterdam port, Argentina, and Brazil prices (Margarido *et al.*, 2004). As at December 2004, soybean sold at USD 228 per ton CIF Ravenna. Similarly, large world soybean producers sell the product at between US$ 200 and US$ 323 MT^{-1} CIF Rotterdam (**Table 9**). The world soybean price increased by 48% in 2007/08, driven by a stagnant supply and strong world demand (European Communities, 2008). It is expected to continue to rise over 2009/10 because of shrinking carryover stocks. With time, area expansion in South America and yield improvement will stabilize the price upto a projected 2017/ 18. However, the soybean price is not expected to return to its historical levels for the remainder of the decade. Because of corn area expansion in 2007/08, U.S. soybean production shrank by 19% and pulled the world soybean output down by 6%.

World production is expected to recover by 10% in 2008/09 as the U.S. and Brazil respond to the record high price (European Communities, 2008). Encouraged by expected price increases, Brazil's soybean area expansion is expected to post an average growth of

3% annually upto 2017/18; Brazil is expected to outpace the U.S. to become the leading soybean producer in 2016/17. World production is expected to reach 297 MMT at the end of the outlook period and is concentrated in Argentina, Brazil, and the U.S. By 2017/18, Brazil will hold a 31% share while the U.S. contributes 30% of global production. Falling real domestic prices and expanding urban area will cause a very limited growth in China's soybean production.

Meanwhile, robust economic growth encourages domestic consumption to increase by 40% over the next 10 years. Policies favoring oilseed imports and domestic crush make China the world's leading soybean importer. China will expand its imports to 52 MMT, accounting for 55% of total world imports over the next 10 years. This strong demand for soybeans becomes a focus of attention for major exporting countries. Brazil and the U.S. dominate the soybean net exports market. Brazil surpassed the U.S. to become the largest soybean net exporter in 2007/08. Brazil's export share reaches 59% by the end of 2018 while the U.S. share of world soybean net exports is projected to decline to 25% in 2017/18. Paraguay is expected to emerge as an important soybean net exporter and holds a 7.6% share of the world market. The price of soybean meal soared by 53% during the 2007/08 season because of high soybean prices.

Prices are expected to decline over the period (2008-2018) as production outpaces demand from the livestock sectors around the world. World soybean meal production will be expected to grow by 2.5% per year on average over the next decade in response to rising feed demand.

China is likely to increase its consumption by 3.4% annually because of strong expansion in its livestock sector. U.S. domestic consumption will likely expand by 19% over the next decade whereas the U.S. share of world consumption is expected to fall slightly. The volume of net exports in the soybean meal market will increase by 32% by 2018. Argentina, the leading soybean meal net exporter, will export 98% of its production to the world market because of its differential export tax policies. Argentina will export 40 MMT by 2017/18 and its market share will grow to 52%. The EU is expected to remain the top net importer, accounting for 38% of world net imports. The price of soy oil will rise over the projection period because of escalating demand for both food and bio-diesel uses. Because of its income and population growth, China became the largest soybean oil consumer in 2006/07 and continues to increase its share, accounting for 29% by 2017/18. Because of their bio-diesel mandates, Argentina, Brazil, and the U.S. are expected to increase soybean oil industrial use by 187%, 208%, and 101%, respectively, over the next decade.

Exports is likely to be dominated by a few countries, but importers will be diverse. Despite the domestic biodiesel mandate, Argentina will still dominate world soybean oil exports, satisfying 72% of the world market. Brazil and the U.S. together will account for 21% of world soybean oil net exports by 2017/18 while China and India's combined share of net imports will hold 48% of the world market.

There seem not to be any particular soybean pricing and marketing policy in Kenya. The free market principle and the market forces of demand and supply seem to determine what happens.

Table 9: World soybean prices 1993 -2004 CIF Rotterdam

Year	93	94	95	96	97	98	99	00	01	02	03	04
US$/Ton	264	259	248	304	307	259	225	208	200	203	267	323
US$/Kg	0.264	0.259	0.248	0.304	0.307	0.259	0.225	0.208	0.200	0.203	0.267	0.323
US FGP[1] (US$/Ton)	213	233	205	263	274	230	176	173	167	170	209	291

Year	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
US$/Ton*	496	506	478	483	478	484	487	491	490	492	487
US$/Kg											
US FGP[1] (US$/Ton)											

[1]US FGP- Farm gate prices

Source: Adapted from Malema (2005) who originally sourced from USDA. * CIF Rotterdam prices (2007- 2018) sourced from European Communities, 2008.

11. Soybean market outlets in Kenya

Following the soybean uses as indicated above, soybean markets in Kenya could be divided into four main categories: (i) Household consumer markets, (ii) Institutional consumer markets, (iii) Industrial consumer markets, and (iv) Animal feeds markets.

At the household consumer market level, the exact quantity of soybean consumed in Kenya is not well known. Most sub-sector observers feel that the market is very small (< 1% of total national human consumption of soybean) compared with the other market outlets (institutional consumer market, industrial consumer market, and livestock feeds market).

At the main Kenya border points with Uganda and Tanzania, there are only a few major soybean brokers. Apart from these few big brokers, there is not much wholesaling of whole soybean in the country because the sub-sector is still small at the moment. Retailing of soybean (whole grains) is commonly observed in the open-air markets in urban centers, municipal markets in urban centers, and grain stores in urban centers.

With respect to soybean products of human food processors (e.g., Proctor and Allan, House of Manji, etc.) and human food and livestock processors, there is a relatively high intensity of wholesaling. For instance, human food processors make wholesales to institutional consumers (e.g. WFP for refugee feeding). Similarly, the human food and livestock feed processors make wholesales to human food retailers such as the supermarkets and also to livestock feed retailers (mainly in medium to high potential areas of the country where zero-grazed livestock feeding is more concentrated). Like the whole soybean grains, retailing of processed soybean products also happens through the open-air markets.

12. Technological, institutional and infrastructural environment

12.1 Suitability of soybean cultivation in Kenya

Kenyan conditions are suitable for soybean cultivation. The main factors include congenial agro-ecology, crop compatibility with existing farming systems, soybean's potential contribution in natural resource management, low cost of soybean protein, soybean's contribution to food security, its potential to contribute to bio-fuel energy, and its ability as an economic crop to create employment and generate income. Further regarding fuel production potential, soybean biodiesel produces low-carbon, and mid-carbon chains, which burn more completely with less carbon emission and metal oxide pollution risks (http://extension.agron.iastate.edu/soybean/uses_biodiesel.html).

12.2 Potential for natural resource management

Soil fertility decline is the main biophysical cause of poor crop yields in Kenya. However, many farmers do not use inorganic fertilizers due to poverty. The farmers who use inorganic fertilizers often apply insufficient quantities also due to the high cost of inorganic soil inputs. This leads to steady soil mining and negative soil nutrient balances. Inclusion of soybean in the farming systems can contribute to an improvement in soil fertility since, as a legume, soybean fixes nitrogen (one of the plant nutrients lacking in most of Kenya's soils) from the atmosphere. The dual-purpose varieties of soybean are usually more effective in fixing atmospheric nitrogen. Since soybean is effective in fixing atmospheric nitrogen, it makes little or no demand on soil nitrogen and actually spares the same for the subsequent crop in a rotation or the companion crop(s) in an intercrop. The biomass from soybean is also an important source of feed, green manure, and mulch. Besides, soybean is relatively drought resistant and makes efficient use of available soil water resources. Soybean needs less water to grow than crops such as maize and can consequently be cultivated in regions with intermittent rainfall patterns. This explains why soybean is grown during both the long rain season and the short rain season in Kenyan farming systems. Above all, soybean is friendly to the environment, with significant benefits on the agro-ecosystem. Among others, these benefits include soil fertility improvement through nitrogen fixation into the soil and through the provision of biomass that can be integrated as organic mulch in the soil. The dual-purpose soybean varieties are particularly good in both nitrogen fixation and provision of mulch materials. Sanginga *et al.* (2003, pp 305-314) estimated that soybean N fixation ranges between 44 to 103 g N/ha, leading to a substantial savings in fertilizer costs.

12.3 Affordable protein source

Protein-energy malnutrition (PEM) is one of the major problems facing the households in Kenya. This is due to poverty that reduces the access of households to the traditional sources of protein such as meat. Soybean has been demonstrated to be an alternative and affordable source of protein for the low-income consumer. One kilogram of soybean has double the protein of meat but the cost of soybean is about two and a half times less than of meat. When compared with other legumes and livestock products, soybean has the lowest price per kilogram of protein when compared with cowpea, milk powder, poultry, pork and beef (Osho, 1995). This is corroborated by a recent calculation based on retail prices in Nairobi markets, presented in **Table 10** (Jagwe and Owuor 2004).

Table 10: Relative Cost of Protein from different sources in Kenya

Protein source	Retail price (KSh./kg)	Protein content (%)	Cost of protein from source (KSh./kg)
Soybean (dry)	30	40	75.00
Milk (per litre)	40	36	111.11
Common beans (dry)	25	20	125.00
Cowpeas (dry)	32	20	160.00
Maize flour	25	9	277.78
Fish	90	20	450.00
Beef	120	20	600.00
Millet flour	24	4	600.00
Chicken	160	20	800.00

Source: Jagwe and Owuor, 2004

12.4 Contribution to food security

Three main characteristics make soybean outstanding as a food security crop. First, soybean matures early (depending on agroecological zone, with some varieties maturing in 90 to 100 days). The second factor is soybean's drought tolerant characteristic, which enables the crop to yield under water stress while many other crops fail due to drought.

Thirdly, soybean has a high commercial index. Presently, soybean-producing households consume about 80% of the production, while marketing 20% (mainly in local open markets), implying a commercial index of 0.25 or 25%. The high commercial index indicates that soybean can easily be traded to supplement household cash income needs. A recent estimate shows that soybean producer or farm gate prices range from Kshs 30 – 50 per kg. On the other hand, retail prices range from Kshs 40 – 80 per kg. However, the main soybean industries that use soybean as a raw material in processing offer to buy soybean from the farmers at about CIF Mombasa price (ranges from KShs 27 to KShs. 42) of imported soybean.

12.5 Employment creation and income generation

Soybean grains serve as raw materials in livestock feed industries, edible vegetable oil processing industries, and other human food manufacturing outfits. In these forward linkages or uses, soybean creates employment and leads to income generation. Small-scale home processing of soybean into various products also creates employment and enables households to increase their access to cash income, thereby effectively contributing to poverty (through income and employment generation) reduction – an important development agenda. Also, due to the short maturity period of some varieties of soybean, they can provide cash income at a time when many other crops such as maize and sugar are still in the field. At the national level, embracing soybean production and some level of processing can lead to foreign exchange savings in Kenya since the country current import bills on vegetable oils alone is estimated at approximately US$ 172 million annually. In addition, smallholder farmers will prosper through this new and alternative cash crop. Aside from prospering financially, their families would be healthier with more protein in the diet. Like was the case with Nigeria, women would be generating income by selling soybean-based snacks.

13. Institutional and regulatory environment

13.1 Institutions with potential for leveraging interventions

Some of the major industrial soybean product processors in Kenya include the following (feed meal manufacturers, etc): Kitale Industries (Faida feeds), Western Seeds and Grain, Elgon feeds, ADC farms, Lake Feeds, United millers, Millennium millers, Ima feeds, Arkay feeds, Mau Kim International, and Turbo Feeds. As consumers of soya products, these animal feed millers are potentially important institutional nodes if business collaboration with farmers is established.

13.2 Soybean sub-sector positive driving forces

Driving forces refer to those factors that are at the root of the dynamics and change within the sub-sector. These often relate to market demand, technological change, barriers to entry into the market, input supply, and profitability level of different market or product niches, risks or policies. In this regard, the main positive driving forces of the soybean sub-sector in Kenya today include the following:

(i) Existence of considerable industrial base

In Kenya, there is a considerable industrial base capable of utilizing soybean. This is especially with respect to domestic livestock feed industry and is also exemplified by the huge number of flourmill processing companies in the country and the multiple utilizations of soybean in the manufacture of soybean-based nutritive and high value food products. The livestock feed industry is growing rapidly as the zero-grazing systems for dairy and beef animals, piggery and poultry continue to develop. Poultry feeding accounts for the largest proportion of animal feeds and has had the most rapid growth over the last two years.

(ii) Mass feeding programmes

This programme is designed for the large and increasing refugee population in Kenya, occasioned by political instability in neighbouring countries such as Somalia and Sudan. The feeding programme is carried out using unimix, edible vegetable oils, and other high-protein food items (soybean ranking highest).

(iii) Emerging EU trade regulations under the EUROGAP protocols

This is on general food safety and traceability. It requires that meat, pork, milk products, and eggs exported to the EU markets should be from animals and birds that have not been fed with animal fat and proteins. This makes soybean a very good candidate given its high protein content relative to other crops. Most producers of exportable livestock products are turning to soybean. As other consuming markets (including the local market) increasingly adopt this requirement, the soybean sub-sector is sure to reap tremendous benefits. The other local sources of proteins for livestock feed preparation has been *omena* fish from Lake Victoria, but the sector has had its own problems besides being less favoured by the emerging trend in market regulations and requirements.

13.3 Land tenure

The major system of land acquisition in Kenya is inheritance. Land is held mainly in one contiguous piece with some additional exploitation of rented plots (Place *et al.,* 2005). Land renting or leasing is also common but mostly in the sugarcane belt such as *Mumias*, *Nzoia*, some parts of Busia district, Chemelil, Muhoroni, and Awendo. Rich farmers also lease in or rent-in land from poor farmers for one or two years. This is done almost everywhere especially in *Luo* community where there seems to be plenty of land. In places where population density is very high (e.g., Vihiga, Kakamega, and Kisii districts), it is much more difficult to see parcels of land for renting in or leasing in. Land renting can also be paid for in kind. This is termed *pur wabar* in *Luo,* meaning plow we divide. After the division, the other operations are completely independent. This system enables the poor and the landless households to secure land for agricultural production, using the only resource (labor) they have for payment. This system works much better in areas where land scarcity is not yet acute and where work animals are used for cultivation (over 80% of the cases in *Luo* land). This explains why such a system might not work well in *Luhya* land where land is scarce and as a result farm sizes are generally small.

Land is fully registered, individually owned, and titled in most parts of Kenya (Place et al., 2005). As inheritance progresses, what to inherit becomes smaller and smaller. This leads to over use of land and reduction in productivity. The limited land forces the farmers to devote more attention to staple food crop even when it does not seem to be profitable, explaining the dominance of maize in the farming systems. This again, is strongly attached to the people’s culture of using maize for gifts, church offerings, and gift to the sick. Culturally also, the farm households feel food secure for as long as they have maize in store. Maize is also preferred to sorghum and millet due to its white color and taste. Besides, it sells fast compared to sorghum and millet. However, the price per unit of millet is usually higher than that of maize and sorghum.

It is also possible to purchase parcels of land in Kenya. Each administrative division has a Land Control Board charged with the responsibility to ensure that no Kenyan family is left without land, probably by selling off of all its land for any reason. No land can be sold without first consulting with the board, no matter how cogent the reasons may be. The board must endorse land sales because the government only issues title deeds at the advice of the board. The land seller must convince the board on the reasons for wanting to sell the land. The board reserves the right to allow or not to allow the transaction, depending on the weight of the reasons given by the owner. The board usually comprises of about 10 members (men and women). In principle, the District Commissioner (DC) is the chairman but can delegate the presiding function to any other member whenever he intends to be absent from board meetings.

Farmers will not accept conservation measures unless the long-term advantages will accrue to them and not to others who may be occupying the land, or reaping the advantages (through taxation, for example). This explains why security of tenure is a prerequisite to investment in land development.

13.4 Congenial agro-ecology

Soybean is essentially a short day plant that is not affected by the photoperiod in the tropics. A large area of Kenyan land (highland areas, medium altitude areas, and lowland areas) is potentially suitable for the cultivation of soybean. However, estimates of what this translates to in terms of hectares have varied significantly depending on the source of data. This ranges from 157 000 ha (estimated by the MOA in 1995) to 224 000 ha (estimated by LBDA). Uasin Gishu, Trans Nzoia, Siaya, and Bungoma districts account for the largest proportion of land potentially good for soybean production. A GIS support will be needed to get an improved version of this estimate.

A total of 21 varieties, developed under lowland conditions, were imported from Nigeria and after testing under research conditions, 10 of them proved suitable for Western Kenya (*highland areas*, *medium altitude areas*, *and lowland areas*). The researchers are interested in the total value of improved soybean varieties (high grain yield, the ability to fix atmospheric nitrogen into the soil for fertility enhancement, high biomass production, etc.). In collaboration with farmers, many of these varieties (e.g., SB3, SB5, SB8, S11, SB19, and SB20) are now being demonstrated in many districts of the Western Province of Kenya. Results show that these new varieties have yielded as much as 2.4 t ha^{-1} while possible yields for the currently used varieties (local and older varieties) are much lower, going up to only 1.8 t ha^{-1} (or 75%) under good farm management (Wafula, personal communication). According to KARI (Kenya Agricultural Research Institute), it is possible for farmers with good management to harvest yields between 1.4 and 1.8 t ha^{-1}, depending on the varieties grown and agroecological zones. The average yield obtained by small-scale farmers in the area is about 0.6 t ha^{-1}, a mere 25% of what the yield obtained from the improved varieties being demonstrated under trial conditions.

In Kenya, using volume of soybean production as a proxy for the number of soybean farmers, and number of processing organizations as a proxy for the concentration of consumers, the main geographic clusters of soybean producers would include: *Busia*, *Bungoma*, *Butere*, and *Mumias* districts (which together produced an estimated 80% of total output in Western Province in 2003). On the other hand, the main trade and consumption cluster areas would include: *Kisumu*, *Kakamega*, *Bungoma*, *Kitale*, and *Kisii* districts. In terms of potential for maximization of impact of interventions from a geographical cluster point of view, these areas would provide appropriate entry points where soybean promotion efforts would need to be concentrated. Going by the rule of thumb that soybean can perform well in areas where maize performs well, many parts of

Kenya, especially the western region, fall into this category.

13.5 Compatibility with existing farming systems

The main question here is ‘how easy or how difficult is it to include soybean in the existing cropping systems? Most parts of Kenya are endowed with bimodal rainfall distribution. These are the long rainy season (March to June) and the short rainy season (August to November). The most important cropping pattern is intercropping (especially maize with common bean), which is increasing with increase in land scarcity due to population pressure. Across Kenya, intercropping accounts for about 75% of the total annual acreage and occurs during both the long and the short rainy seasons, but more so in the former. The long rainy season is the main production period and it accounts for about 75% of total annual production of soybean in the Western Province. The usual practice is to intercrop cereals [maize, sorghum (*Sorghum bicolor* L.), and millet (*Eleusine coracana* L.) in that order] with many other crops including grain legumes in most cases. Soybean/maize intercropping is also commonly practiced in the farming systems of Kenya, especially during the long rainy season. Over 70% of the soybean crop was intercropped with either maize or sugarcane in *Kakamega*, *Butere*, *Mumias*, *Busia*, *Teso*, and *Kisii* districts in 2003. The balance was grown under pure stands or sole crop. Many improved soybean varieties such as Namsoy 4M, Maksoy 1N (both of which were released in Uganda in 2004), and some of the multipurpose promiscuous soybean varieties (the TGx or Tropical Glycine crosses series) are suitable for intercropping. Where intercropped, the multipurpose soybean varieties have shown the capacity to minimize the threats from Striga (*Striga hermonthica*) – a parasitic plant that attacks cereals, causing a heavy reduction in yield, threatening the farming systems in Western Kenya.

Intercropping is followed in popularity by rotational cropping systems in which pure stands of a crop are rotated. This is commonly practiced during the short rain season. Across Kenya, this practice accounts for approximately 25% of the acreage in the farming systems and is usually preferred in areas where land is not yet very limiting. Over 70% of the land planted with soybean in *Trans-Nzoia*, *Bungoma*, and *Nyando* districts in 2003 were under sole cropping. A pure stand legume such as soybean is usually rotated with maize or other cereal crops. Soybean fits in well as a rotational crop (in pure stands) in many cropping systems in Kenya especially those involving maize, sugarcane, barley, and wheat.

Rotating cereals with soybean reduces weed pressure and the problems of pests and diseases. Hence, incorporating soybean can generate spare labor (especially of women and children) that could be channeled to other productive uses such as crop processing for an overall improvement in household productivity, livelihood, and general welfare. A field earlier planted with soybean is usually in a much better condition for the cultivation of subsequent crops due to lower plowing cost and better soil fertility due to N-fixation.

From the above, it is clear that the emerging scenario is that in the districts where land is scarce, intercropping is the most common practice. However, in the areas where land is not limiting, pure stand soybean production is the preferred system.

13.6 Second season opportunity

In the farming systems of Kenya, maize is the most commonly intercropped with common beans during the long rainy season (March to June). Maize can also be intercropped with soybean during the same long rainy season. Under this condition, soybean will surely be competing with both maize and common bean for the farm resources (land, labor, capital, management, etc,). However, according to the farmers, during the short rainy season (August to November), soybean is most suitable crop to grow even as pure stands because maize does not usually do well during the short rainy season due to the impact of maize streak virus that devastates maize grown during this season. Besides, while there is the tendency for many crops to fail during the short rainy season, soybean generally survives due to its high drought tolerance capacity. In this way, soybean can be a vehicle to bring about sustainable intensification (on already cultivated land) of agriculture and the cropping systems in areas where poverty, population growth, and increasing demand for food is already driving the expansion of cropped area into marginal and very poor lands.

13.7 Market potential

In Kenya, there are over 80 livestock feed industries mostly located in Nairobi, Nakuru, and Thika. The livestock feed industries accounts for about 90% of the total consumption of soybean in the country. Total consumption of soybean by the livestock industries increased from approximately 354 000 MT in 1998 to about 437 000 MT in 2002. The market grows at about 5.3% per annum and is largely dependent on imports because of lack of local supply sources. The main uses of soybean in livestock feed manufacture include dairy meal, poultry feeds, and pig feeds. Kenya has faced chronic and substantial deficits in edible oils, with over 65% of domestic needs currently being met by imports. The edible oil industry has significant forward linkages with the livestock feed industries and therefore has a high potential for saving foreign exchange. According to Kenya Accelerated Food Production Programme (KAFPROD) import bills for edible vegetable oils and protein cakes in the early 1990s was estimated at well over US$80 million annually while it is currently estimated at US$172 million per year. A report from the Foreign Agricultural Service Global Agricultural Information Network of USDA (2002) on Kenya Oilseeds and Products estimated that in 2002, Kenya's vegetable oil requirements were between 350 000 (by MOA) and 380 000 MT per annum (by FAO) depending on the source of data. The Ministry further estimated per capita oilseed consumption of 5.7 kg annum^{-1}. The country's domestic output covers only one-third of its annual demand with the rest being imported (mainly palm oil from Malaysia). The total import volume of both vegetable oils and fats in 2002 was about 390 000 MT at the cost of approximately US$172 million making the commodity the second single most important import item after petroleum. These statistics indicate great opportunities for import substitution possibilities using domestically produced soybean.

13.8 Profitability

Recent results based on gross margin (GM) analysis show that with the improved dual-purpose promiscuous soybean varieties (the TGx series) that has a yielding capacity of over 3 t ha^{-1} for pure stands over two seasons, the soybean enterprise is highly profitable to farmers in Western Kenya. At a producer price of KShs 22 kg^{-1} (which is low by current level of over KShs 40 kg^{-1}), this translates to a GM of KShs 52 800 ha^{-1} (for the two seasons). This implies that the dual-purpose soybeans variety has the capacity to achieve about Kshs 26 400 ha^{-1} $season^{-1}$ of pure stand. Since many farmers in Western Kenya intercrop soybean with maize during the first season and grow pure stands of soybean during the second season, this study also evaluated GM based on this farmer practice. By growing soybeans for two seasons with one (first season) intercropped with maize and the other on pure stand, the GM only declined marginally to KShs 51 543 ha^{-1} (still a substantial amount). The other indicators of soybean profitability, especially if processed can be seen from Chianu *et al.* (in press). For farmer preferred varieties based on participatory farmer evaluation (Chianu *et al.*, 2006).

13.9 Political stability

Notwithstanding the violence that followed the December 2007 elections, Kenya enjoys a fairly political stability that creates conducive atmosphere for development (including crop development) by reducing risk. This atmosphere can also be enjoyed by the soybean sub-sector and can eventually lead to soybean export, just like is currently happening with the horticultural products and their exports (Diao *et al*., 2003).

13.10 Soybean disease resistance

Compared with soybean, common bean plants are affected by many diseases. Common beans are susceptible to diseases, and several diseases are responsible for significant yield and economic losses in Africa (Buruchara, 2005). An estimated total of 2, 288,000 tons of common beans are lost to diseases annually (Wortmann *et al*., 1998). This explains why rouging (the practice of removing common bean plants that show signs of disease so as to prevent the disease from spreading to the healthy plants) is commonly practiced in common bean production unlike in soybean cultivation. According to Misiko *et al*. (2008), soybean is a recent introduction in much of Africa and therefore has fewer disease and insect problems than other grain legumes.

13.11 Competitiveness of the soybean Sector

Calculations by Jagwe and Owuor (2004) estimated the cost of producing soybean in western Kenya at US$ 175 per metric tonne. Data from FAO indicate that the cost of soybean production in the United States of America ranges from US$ 160 to US$ 170. This shows that soybean production in Kenya is competitive in the global market and can further be improved upon if the cost of soybean production in Kenya can be reduced through comprehensive research on ecological, edaphic, and agronomic factors (Jagwe and Owuor, 2004). Following this approach to improve production efficiency, the crop would become more attractive to the farmers; especially linkages with the market, including the international market can be developed.

13.12 Salient qualities of 'new' soybean varieties

These 'new' varieties are often referred to as dual-purpose varieties since they are accompanied by many attributes including grains, cash, and net-N incorporation in the soil from which subsequent crops can benefit. As a result, the integration of improved soybean varieties into the existing farming system creates potential benefits from which smallholder farmers can benefit. Due to their attributes and potentials (e.g., high N-fixation, ability to suppress Striga, high net returns, etc.), the promiscuous dual purpose soybean varieties could trigger and sustain the acceptance of soybean in Kenya and other East African countries.

14. Constraints to large-scale soybean adoption in Kenya

(i) Competition from imports of edible oils (e.g., palm oil from Malaysia)

A significant number of sub-sector observers argue that duties charged on such imports have tended to place the local edible vegetable oil industry (characterised by lack of development policy, organized marketing arrangement, and low productivity) at disadvantaged position. Competition from cheap imports negatively influences domestic production.

(ii) Lack of seriousness among large-scale soybean processing companies

A number of processors (Sigma Feeds, Elianto, Highlife Products, etc.) bought soybeans from farmers in the past or even tried to promote soybean cultivation. However, the efforts of these companies were usually not very fruitful for many reasons, including making unfulfilled promises (to buy soybean from farmers) to farmers. In 1997, farmers went ahead to produce substantial amount of soybean because Elianto promised them a good market (at a chiefs' *baraza*) but did not eventually to buy the produce (Kaara *et al*., 1998). Farmers had to sell to a livestock feed producer (at *Maragua*) and at a rock bottom price of 15–25 Ksh kg^{-1}, a price that farmers considered to be too low· In response, farmers drastically reduced soybean production the following year (1998). Sometimes, the processing companies fail to make clear business commitments (with respect to the prices they would pay farmers at harvest or other sales conditions expected of soybean farmers).

(iii) Lack of sub-sector policy

Another realm of constraints can be situated in policy obstacles or lack of supportive government policy. Historical records show that soybean has been grown in Kenya as far back as 1904 and yet it has not taken root in the farming systems. Lack of supportive policy has contributed to the failure of all the past attempts to promote soybean in Kenya. This shows that soybean has had little attention in terms of the overall agricultural sector policy and development agenda compared to other major agricultural crops [e.g., tea, coffee, sugarcane, cereals (especially maize), beef, milk, horticultural crops, etc.] produced in the country. There has never been a specific policy for the edible oil sector as a whole (including soybean, simsim, sunflower, groundnut, copra, coconut, rapeseed, palm oil, etc.) in Kenya (Consultants report, 2004). The only attempt to develop a policy framework relevant to soybean and other oil seeds occurred under the auspices "National Oilseeds Development Policy Paper of 1998" initiated under the World Bank-funded Agricultural Sector Management Project (ASMP) and coordinated by the Ministry of Agriculture. Although this attempt was aborted, a major recommendation contained in the draft report was the establishment of Oilseed Development Council to undertake all issues concerning the development of the overall oilseed sub-sector. This draft report was never finalized and is still lying at the headquarters of the Ministry of Agriculture. It is alleged and contended that the edible oil importing interest and mafia groups have been blocking the process. This, however, needs to be verified. Apart from this, the Kenya Agricultural Mart (a lobby organization) has been attempting (without success) to find ways of facilitating farmers to contract with the buyers. Oil Crop Development (OCD) operated in the late 1990s and was involved in bulking, storing, packing, and marketing of certified soybean seeds. In 1998, OCD marketed 10 – 12 tons of soybean seeds and sold mostly to the Coastal Development Authority, stockists, and individual farmers in western Kenya (Krause and Wasike, 1998). Soybean varieties C103, C2, and Hill were among the varieties marketed by OCD. Between 1994 and 1996, KAFPROD promoted the establishment of strong soybean production base (especially in *Busia* and *Kakamega* districts where farmers were provided with suitable varieties including J499) and provided the Home Economics staff of the MoA with training on soybean utilization (Kaara *et al*., 1998). The project supplied OCD with soybean seed. Once the stock supplied by FAO-KAFPROD was sold, no further seed could be made available through OCD since the supply by KAFPROD ran out (Krause and Wasike, 1998). The effect of policy on the promotion of soybean production is amply demonstrated by the Ugandan case. This explains why all the national soybean statistics (acreage, production, yield, demand, etc.) in Kenya are mere estimates and vary significantly depending on the source. The absence of any policy on soybean in Kenya is an indication that one of the aims (although silent) for involving the Ministry of Agriculture (an important public agricultural policy institution) by almost all the past projects that promoted soybean production might not have been attained.

(iv) Lack of commercially viable, adaptable, and affordable technology

This is especially important to small and medium-sized business operations. Currently, soybean processing is characterized by the existence of large industrial processing at one end of the technology continuum and artisanal /cottage and household level processing technologies (crude and rudimentary) at the other end of the continuum. There is little or no intermediate processing technologies between large industries and artisanal or basic household level processing technologies.

(v) Lack of consistent supply of high yielding soybean varieties

Some of these are especially important for biological nitrogen fixation necessary for enhancing soil fertility that already constitutes a problem in many farming systems in Kenya. Most of the varieties currently being cultivated have limited or no ability to naturally fix high amounts of atmospheric nitrogen into soils and often require artificial rhizobium inoculation, a technology that is often not accessible to many smallholder farmers, given that the only source is the University of Nairobi (Kabete Campus), despite being cheap (KShs 100 for 100 kg of seed, that is more than enough to plant up a hectare of farmland). In addition, most farmers do not use fertilizers (organic and inorganic). Consequently, soil fertility has continued to decline resulting in low yields and low competitiveness of locally produced soybean with imports.

(vi) Poor Agronomic Practices and Declining Soil Fertility

In Kenya, where low soil fertility is already a problem, it is not uncommon to observe poor agronomic practices (e.g., intercropping two or more cereal crops, poor knowledge about recommended crop varieties, inappropriate crop husbandry methods, low use of nutrients, poor pest management practices, inadequate control of weeds, low combination of organic and mineral fertilizers, etc.) among the smallholder farmers. This needs to be dissuaded with grain legumes such as soybean and common bean (through which the soil fertility-improving effects of legumes for the benefit of farm households and the environment can easily be demonstrated on the companion crops in an intercrop arrangement or on subsequent crop(s) in crop rotation. The cultivation of soybeans (especially the dual-purpose varieties) improves the soil where grown (Greenberg and Hartung, 1998). When soybean was first introduced to USA, it was called "green manure" because of its positive effect on the soil (Greenberg and Hartung, 1998).

By using on-farm generated seeds, there has been a tendency to mix-up varieties thereby losing seed purity. The problems associated with seeds partly explain the low yield (0.56 – 1.10 t ha^{-1}) and wide variability in soybean yield in Kenya. Research findings indicate that it is technically possible to obtain up to 3 t ha^{-1} with good seeds for recommended varieties and good agronomic practices. Average yields in Western Kenya range from 0.4 t ha^{-1} (*Teso* district) to 0.8 t ha^{-1} (*Butere* and *Mumias* districts).

Seed varieties previously promoted in Kenya have been found to have low natural ability for fixing nitrogen into the soils and hence the need for artificial rhizobium inoculation. This has been compounded by the poor accessibility of the inoculants. The low nitrogen fixation capacity of the traditional varieties may have partly been responsible for the decline in soil fertility as reported by some Ministry of Agriculture extension staff and some soybean growers interviewed.

Since 1990s, TSBF-CIAT has developed and tried the multipurpose soybean varieties specifically the TGx series that are characterized by high promiscuous nodulation. The varieties are called ‘dual-purpose’ because they not only produce grains like the traditional varieties but also have properties (poverty alleviation, income generation, soil fertility among others) that are highly desirable in Kenya. Recent trials by TSBF in Western Kenya have demonstrated the positive attributes including higher yielding capacity of the dual-purpose varieties (almost double what is usually obtained from the traditional varieties), increased biomass production and higher net nitrogen addition into the soils.

(vii) Lack of institutional coordination and collaboration

The past initiatives on promoting soybeans have been undertaken by a multiplicity of actors (public sector, private sector, donors, NGOs, etc), each tending to operate independently, with very little coordination or collaboration among them. In addition, more often than not, each promoter focused on a selected number of areas of intervention along the soybean supply chain. Only few stakeholders attempted a holistic and vertically integrated approach. This affected the development of the soybean sub-sector. For example the FAO-KAFPROD working with Villa Maria (an NGO) focused much more on the promotion of production (through increased supply of seeds) and a little bit on linking farmers to market. The GTZ project (SPB) focused on variety development and soybean utilization and took the initiative for soybean seed production through different channels (Krause and Wasike, 1998). Strengthening of marketing organization, establishment of market linkages, promotion of appropriate and affordable processing technology, promotion of widespread household utilization have all not seriously been attended to by many of the past initiatives. The lack of coordination and collaboration between and among the promoting agencies has not only tended to confuse farmers, but has resulted in very insignificant and unsustainable impact on the soybeans sub-sector as synergistic benefits were lost.

(viii) Low efforts towards developing domestic institutions

Since most of the past initiatives were the main buyers of the soybean produced by the farmers, they did not see the need to develop or strengthen local institutions such as farmer organizations and cooperative societies for sustainable marketing and production of soybean. Apart from helping farmers to market their soybean effectively and efficiently, well-strengthened farmer organizations and cooperatives would have provided other important agricultural production services and functions such as agro-input supplies and easy access to credit to the farmers who often lack access to formal credits due to lack of collateral securities, the fear of default in paying back, and high cost of administering credit to smallholder farmers with fragmented landholdings scattered here and there. Many credit institutions prefer reaching out to small-scale farmers through farmer organizations and cooperatives – important means of waving the need for collateral securities by individual farmers, and reducing credit default rate and the cost of credit administration. The neglect of the need to develop local institutions was a big oversight because it led to the loss of the advantages in agricultural development associated trust and collective action such as the economies of scale.

(ix) Low import price of soybean meal

Until recently, the CIF *Mombassa* price level of soybean meal was about US$ 280 t^{-1} on or KShs 22. 4 kg^{-1} (Jagwe and Owuor, 2004). Even with value addition, this price was far lower than the farm gate price of soybean grains in Kenya that ranged from 35 to 45 KShs kg^{-1}. In the open market, the price range for soybean grains has been between KShs 50 kg^{-1} and KShs 60 kg^{-1}. This price differential creates sufficient incentives for the livestock industry which accounts for about 85% of total annual domestic consumption of soybean in Kenya to continue to import soybean meal. Most of the soybean meal (about 85% in 2002) imported into Kenya comes from India. However, recent world food price crisis has led to a situation whereby the CIF Mombasa of soybean has increased over $ 500 t^{-1}. This has also increased the domestic sourcing of soybean by some of the major soybean processing companies. This notwithstanding, since the high cost of domestic production of soybean has been contributing to the higher price expected from soybean by the farmers than world market price, the current soybean projects in the country are working hard to reduce the cost of domestic soybean production in Kenya in its bid to increase profitability. Emphasis has been on the identification of cost inputs that can be removed without any significant effect on yield. Such cost items include third weeding and top dressing.

(x) Lack of holistic development approaches in the soybean sector

Most of the project interventions did not focus on the whole soybean sub-sector but instead emphasized on the production segment. Processing and utilization were not taken into account by the projects that promoted soybean prior to 1994. Marketing, an important institution in the production-consumption chain was less articulated in projects, including the GTZ-Soybean Project (1993-1998), which tried to foster the development of the whole soybean sub-sector from production to consumption using an inter-agency (Ministry of Agriculture, Ministry of Health, Ministry of Education, Prisons Department, Nairobi City Council, etc.) and collaborative implementation approach and involving the private sector, NGOs, farmers, and women groups. The GTZ project was implemented in 13 districts: *Bungoma*, *Embu*, *Isiolo*, *Maragua*, *Mbeere*, *Meru*, *Nakuru*, *Kakamega*, *Busia*, *Trans Nzoia*, *Murang'a*, *Homa Bay*, and *Rachuonyo*. With respect to the problems associated with emphasizing only some aspects of the production-consumption chain, some recent soybean projects do not seem to have learnt from the mistakes of their predecessors. For instance, the ATIRI project (in *Kwanza* area of the *Trans Nzoia* district) started in 2002 aiming to scale up soybean production and utilization, without developing the market component. The IFAD-Farmers Field Schools project in *Trans-*

Nzoia district also aimed at promoting soybean production and utilization through group approaches, farmer-to-farmer extension and value-addition.

(xi) Problems associated with donor and NGO-driven initiatives

Similar with most studies, oil crops (including soybean, see **Appendix 1**) research in Kenya in the past has largely been donor dependent and NGO driven. The problems with such initiatives include limited coverage, lack of continuity, and limited inputs in extension services. The latter (i.e., limited inputs in extension services) is worrisome because many staff of the Ministry of Agriculture involved in extension services have only a limited knowledge of soybean production practices. Other problems associated with donor driven projects include donor fatigue, usually affecting projects negatively and where funding abruptly stops, the projects come to a stop leading to vacuums in the implementation chain.

(xii) Possible advantages of joint produce marketing not fully exploited

Farmers may be better off using a different marketing procedure. For instance, it may be in the interest of farmers to work together as a group to jointly market their produce and to enjoy the benefits of economies of scale. For instance, such a collective action can reduce the total marketing costs involved in moving produce from the farmer to the consumer. By joining together to hire a vehicle, for example, farmers working together can save on transport cost. These possibilities that would have made soybean farmers more independent were largely overlooked by many of the past projects.

(xiii) Cost of soybean production

Secondary data indicate that the cost of soybean production is slightly higher in Kenya than in Uganda. This is also true of the general cost of farm labor in Kenya compared with Uganda. This may probably be a reflection of the also high official minimum wage in Kenya (KShs. 6050 or ~US$ 78) compared with Uganda (UGShs. 100000 or ~US$ 50). This slightly higher cost of soybean production in Kenya compared with Uganda must be reduced to make soybean production in the country more competitive in order to ensure that soybean farmers in Kenya capture a fair share of the soybean market in the

East Africa region and also a way for the integration of Kenya-sourced soybeans in the international market for soybean. All the past studies neglected this important aspect of the soybean sub-sector in Kenya. The high cost of soybean production of soybean in Kenya is also caused by the low soybean plant density by farmers (~52% of recommended density) leading to a lower crop value. This implies inefficient use of farm resources and explains why TSBF-CIAT has included planting density as one of the treatments in its ongoing on-farm soybean agronomy trials in East Africa (Kenya, Uganda, and Tanzania). Compared with Kenya, farmers in Uganda hardly use inorganic fertilizers for their soybean production (John Jagwe, personal communication 2005), probably because the soils in Uganda are inherently more fertile than the soils in Kenya, or at least farmers perceive this. This is another reason for a lower cost of soybean production in Uganda compared with Kenya since the farmers do not generally incur the cost of fertilizer purchase and also the cost of fertilizer application unlike their Kenya counterparts.

15. Why many past projects to promote soybean in Kenya failed: Lessons learnt

In the past, there were many research and development projects aimed at promoting soybean in Kenya, especially in the 1990s. These included efforts by KARI, FAO/KAFPROD, and GTZ-Soybean project. The other institutions included IFAD/FAO/MoA-Farmer Field Schools, Mount Elgon Integrated Conservation and Development Project, Sigma Project-South Imenti Development Association, Sugar companies, AMREF, and the International Union for Conservation of Nature (IUCN). However, literature clearly shows that most of these projects failed due to many reasons summarized under the following sub-sections.

15.1 Planning soybean promotion without facts

Accurate data and statistics are of critical importance for good for planning. Available data on the estimates of soybean statistics (potential area of land suitable to soybean cultivation, production level, yield achievement, home and industrial consumption and demand, annual national requirements, etc.) in Kenya are highly unreliable. Available statistics differed very widely depending on the organization providing the estimation. For instance, the estimates for potential area range from 157 000 ha (estimated by the MoA in 1995) to 224 000 ha (estimated by the LBDA in 2004). For the annual domestic production, available estimates range from 1000 MT (by MoA: based on district level aggregation from only small farms), through 4000 MT (by Farmers Own Trading Ltd: a subsidiary company of ABLH), to 5000 (by LBDA). Information on the involvement of large-scale farms in soybean production in Kenya is rather scanty. However, sub-sector observers indicate that about seven large-scale farms (listed above) in different parts of Western Kenya occasionally cultivate soybean. Soybean production by these large holders is not precisely known but estimated at 4000 MT per annum. Between 1999 and 2003, annual average soybean yield in Kenya ranged from 560 kg ha^{-1} (in the Western Province) to 1100 kg ha^{-1} (in the Eastern Province). Research has shown that, with good husbandry practices, it is possible to obtain soybean yields of 3–3.6 t ha^{-1} for recommended varieties (Teresio Riungu, personal communication 2006). There is also a wide variation in the estimates of soybean consumption (home-level and industrial) in Kenya, relative to data sources. Estimates are not comparable as the indicators of interest are measured by different stakeholders. For instance, TSBF-CIAT estimated the ‘annual demand for soybean and related products’ at 70 000 to 100 000 MT. Farmers’ Own Trading Ltd estimated ‘annual domestic consumption’ of soybean in Kenya at 96 000. BIDCO (a large-scale processing company) estimated ‘annual domestic requirements’ of soybean in Kenya as being 100 000 MT, with the Lake Basin Development Authority (LBDA) estimating annual domestic demand at over 150000 MT. Kenya’s overall annual requirements for edible vegetable oils was also estimated at 390 000 MT. Another estimate noted that the total consumption of soybean by the livestock industries increased from approximately 354 000 MT in 1998 to about 437 000 MT in 2002.

Information with respect to soybean and soybean product sourcing and importation into the country is also inconsistent. According to some sources, soybean and related products are imported into Kenya mainly from Uganda, India, and South Africa. According to CBS data, Uganda and South Africa have been the main sources, although according to a study by FOTL/ABLH, India is said to have become a lead source over the last couple of months, especially for soybean meal. This claim is nevertheless not supported by official data from either the CBS or the Export Promotion Council of Kenya. The main soybean-related import products are crude soybean bean oil, soybean cake, whole soybeans, soybean sauce, and refined soybean oil. According to statistics from CBS, Kenya imported about 30 000 MT of the entire soybean products combined having increased from approximately 24 000 MT in 2001. Of these products, while crude soybean oil accounted for 70%, soybean cake accounted for approximately 20%. Inappropriate methods of soybean data collection has resulted in a huge disharmony in the data and information gathered and reported. This confirms that past projects that promoted soybean in Kenya were confronted with planning with poor and conflicting facts, which must have undermined their success.

15.2 Lack of coordination

With the exception of few projects (e.g., GTZ Soybean Project 1993–1998), most of the projects that promoted soybean in Kenya in the past were small, isolated, and limited in scope. A synergistic coordination of such projects would have assisted in both incremental promotion and the overall advancement of the soybean sub-sector in Kenya. The effect of small size, isolated operation, and limited scope of operation of most of the earlier soybean promotion projects became manifest mainly due to lack of coordination of the projects. Lack of coordination and collaboration was apparent among past soybean promoting agencies, farmers, service providers in distribution channel such as the soybean traders and agro-input dealers, and consumers. For instance, lack of market information on needs (e.g., desired characteristics, etc.) of various potential soybean buyers (by soybean farmers) and on local availability of soybean (by the large-scale industrial processors) is due to lack of coordination which results in poor market linkages between soybean farmers and industries (human food processors and livestock feed millers) that utilize soybean raw material.

15.3 Lack of sustainable marketing arrangement

In Kenya, there has been poor linkage between soybean producers and the industrial sector which is the main buyer and user of soybean as raw material. Most of the past projects that promoted soybean production in the country made no attempt at soybean market research and development. Little effort has been made to identify potential soybean markets. A few of the projects that considered market components handled soybean market development in an unsustainable fashion by buying soybean from farmers by themselves. They also offered the farmers an artificially high producer price for soybean that was not linked with the market value. It follows that soybean farmers were poorly exposed to real markets and on how to independently source for markets for their soybean product (seeds and grains). Emphasis was placed on establishing a strong soybean production base without developing sustainable market outlets. As a result, each time the different projects came to an end, the soybean farmers' market outlet for the crop also came to and end. Poor and unsustainable marketing arrangements was a major factor that immensely contributed to the lack of growth in soybean production in Kenya despite the fact that soybean was introduced in the country many years ago (1904) and that soybean has great potential in many diverse farming systems of Kenya. Unfortunately, the present level of soybean production and supply in most of the producing areas of Kenya is insignificant, to draw the direct attention of large-scale feed millers and food processors. The fact that soybean is not usually cooked and eaten like the traditional legumes in the farming system such as the common bean (*Phaseolus vulgaris* L.), but needs some processing, compounded the problem. This was especially so because many farm households did not know the methods through which soybean could be processed and consumed. Otherwise home consumption of the unsold soybean would have partially mitigated the problems of lack of market and stimulated farmers.

The lessons learnt from the non-inclusion of market considerations when promoting a crop is already yielding some fruit in parts of Kenya. For instance, in 2000, an organization called CENART CONSORT started soybean development initiatives in Trans Nzoia district by basically identifying markets for soybean and contracting farmers for the same. Similarly, since 2003, an NGO, ABLH/Farmers' Own Trading Company (FOTL), has been working on enabling Kenya's rural poor to escape poverty and create prosperity by empowering poor farmers to grow selected marketable produce. More information about FOTL can be obtained from www.farmersown.com.

15.4 Undeveloped assembling function and farmers' unorganized marketing

Assembling products for easy marketing is an essential function in commercialized agriculture. Soybean in Kenya still remains largely a subsistence crop. The assembling function in this sub-sector is still small, haphazard, and very poorly developed. Assembling occurs only at the local market centers and the quantities of soybean involved are often far too small to warrant the involvement of large-scale processors (e.g. Bidco, Proctor and Allan, Rift Valley products, etc.) making any attempts to solicit for the produce from these local market centers. Even the artisanal processors (who would normally be looking for much lower quantities of soybean raw materials, say about 100 kg, than the large-scale processors) sometimes also find it difficult to source sufficient quantities of supplies from the local market centers or local soybean assembly points. Many prospective soybean buyers indicate that they have difficulties knowing where to source the commodity. Farmers do not operate organized marketing that could attract buyers. Some limited effort aimed at assembling soybean produce from small-scale farmers have only recently been made by the Farmers Own Trading/ALBH, Soya Afric, and Sigma Feeds through contractual arrangements with the produce (whole soybean grains) being further sold to processors such as BIDCO. The quantities involved are, however, small. For instance, in March 2004, Farmers Own Trading/ALBH got only 6 tons from their contracted farmers while they needed much more than this amount.

15.5 Lack of guaranteed market for soybean

In Kenya, apart from some of the past projects that promoted soybean which were also buying the produce from the farmers – an unsustainable arrangement, there was never any sustainable outlet that was willing to make the kind of commitment that Olivine Industries made in Zimbabwe to encourage smallholder soybean production. Our discussions and interviews with the farmers in the Western, Nyanza, and Rift Valley Provinces of Kenya indicate they are ready to reallocate their agricultural production resources and produce sufficient soybean provided there is a guaranteed market. Most of the farmers in sugarcane growing areas are in need of an alternative cash crop due to exploitation by the sugar companies. This is due to unequal bargaining power between sugarcane farmers and the sugar companies. As a result of this, most sugarcane farmers now suffer from loss of income and are eager for an alternative source of income to compensate for the lost income. In this respect, soybean offers a high potential option, especially following the current strategies of ensuring that farmers capture the benefits of value-addition, through training on soybean processing.

15.6 Insignificant and inappropriate home-level promotion of soybean processing

The Nigerian and Zimbabwean experiences on home-level promotion of soybean processing indicate that success requires a heavy promotion, especially considering that apart from incorporating soybean into the existing local dishes, entirely new recipes and products also need to the developed and fitted into the food habits of the people. In Kenya, despite claims that people consume soybean in many forms, interviews with many farm households, agricultural extension workers, and home economics officers at the district agricultural extension offices indicate that most farm household knowledge is restricted in product range. The result is low soybean utilization at local household level. As a result, cottage industries and other commercially viable small and medium scale enterprises that would have sprang up in support of more widespread processing failed to do so.

15.7 Poor agricultural extension services

Extension services play a lead role in the promotion of new technologies. The Ministry of Agriculture (through the mainstream extension services) provides extension services and training in soybean utilization. Inadequate technical capacity and resources within the Ministry has tended to constrain the ability of extension staff to effectively serve and render adequate agricultural extension services to soybean farmers. Also, there is a limited coverage, making it possible for farmers in some localities to have access to agricultural extension services unlike farmers in other localities. The Seventh Day Adventist (SDA) church loyalists in Kenya prefer soybean beverage to coffee or tea. In order to help its members, the SDA church renders agricultural extension services to its members mainly in the areas of soybean processing and soybean utilization. The ABLH (an NGO) also renders seed supply services, agricultural extension services, and marketing services to its contracted soybean farmers. ABLH also encourages farmers to use manure on their crop. The involvement of some non-agricultural institutions in the delivery of agricultural extension functions sometimes leads to poor information dissemination. The shortage of qualified agricultural extension staff calls for development of a reliable extension infrastructure.

15.8 Spacing and planting techniques

Inappropriate plant spacing has contributed to the low soybean yield (average of about 600 kg ha^{-1} reported for Kenya). Farmers who received advice from extension staff tend to plant according to recommendation (drill in rows 45–60 cm apart). Farmers who did not receive advice from extension staff plant soybean in more or less the same way they plant their traditional grain legumes (dibble at 60–90 cm between rows and 30–60 cm within rows, 2–3 seeds per hill), resulting in lower plant populations than recommended (Kaara *et al.*, 1998). It was not also obvious that the farmers were made aware of the fact that Phosphorus (P) was absolutely necessary for good crop performance in most farming systems in Kenya. For instance, in Western Kenya, growing crops without the application of P is an absolute waste of time and partly explains the widespread low crop productivity (or yields) and continuing high level of poverty in most parts of Western Kenya.

16. Conclusion

The scenario for soybean in Kenya presents a situation of mixed opportunities and challenges. High potential local and global prospects for soybean have been highlighted. However, market and production based imperfections in the soybean sector are a key challenge that should be addressed, especially in the local market.

Several local and global factors are likely to influence soybean development in the coming decade. In Kenya, local soybean demand is large, while most of the demand is met by external exports. Globally, soybean consumption and demand is expected to grow strongly over the next decade. Due to changing food consumption patterns, vegetable oils are likely to be among the fastest growing agricultural sectors, with approximately 60% growth up to 2017. Biodiesel demand will account for 30% of that growth. Over the past decade, meat consumption has expanded, driven mainly by population growth and income rises in developing world economies. Ten year forecasts up to 2018 indicate that meat consumption will grow by 2.5% annually in developing countries. The expected growth in meat consumption stimulates higher soybean utilization and those regions experiencing high economic growth, though actual growth will remain highly variable in Africa. Strong global factors that are likely to influence future soybean prospects and prices include Chinas' economic growth, soybean area and production changes in the Americas, especially Brazil and Argentina, and the global stock-use ratio. In the recent past, global soybean stocks have declined and they are set to decline further in the next decade. How the stock- use ratio is managed will always influence world crop prices, which in-turn influences the local markets.

Soybean has a great potential (in terms of food, income, nutrition and human health, soil health improvements through biological nitrogen fixation, etc.) in the farming systems of Kenya. High profitability has been demonstrated with improved practices and value addition. However, the realization of this potential will depend on a consistent effort addressed along the value-chain (productivity increases, processing and value-addition at both home and cottage or community levels, and effective linkage with large-scale feed and food processors). Coordination, consultation and partnership among all interested stakeholders is critical to not only avoid unnecessary duplication of efforts but also to ensure incremental achievements and advancement in soybean promotion over time.

The main challenges that soybean system faces in Kenya include production inefficiencies as a result of cultivation in small scattered plots, and lack of soybean bulking systems, poor agricultural practices and lack of inputs, and lack of supportive government policies.

Domestic soybean market development through empowerment and social capital asset development of small-scale farmers for collective action is critical. Through this, farmers or farmer groups can perform marketing functions (produce bulking, grading, bagging, storage, transportation, etc.) that would increase the attractiveness of their produce to the large-scale processors. In this way, import substitution would become a reality and will bring about a cash income increase as well as overall improvements in welfare among the rural farmers in Kenya.

References

BIDCO. 2005. BIDCO Oil Refineries Ltd, Thika, Kenya.

Buruchara, R. 2005. Application of biotechnology in bean disease management. Highlights. CIAT in Africa. No. 27, June 2005.

Chianu Jonas, Bernard Vanlauwe, John Mukalama, Akin Adesina, and Nteranya Sanginga. 2006. "Farmer evaluation of improved soybean varieties being screened in five locations in Kenya: Implications for research and development". African Journal of Agricultural Research Vol. 1 (5), pp. 143–150.

Chianu Jonas N and Bernard Vanlauwe. 2006. "Soybean: a new role in western Kenya". Highlights CIAT in Africa, No. 35 June 2006.

Chianu J N, Ohiokpehai O, Vanlauwe B, Adesina A, De Groote H, Chianu Justina, Sanginga[1] N (in press). "Promoting a versatile but yet minor crop: soybean in the farming systems of Kenya". Journal of Sustainable Development in Africa

Consultants report, 2004

Diao, X., Dorosh, P., and S.M. Rahman with Meijer, S., Rosegrant, M., Yanoma, Y., and W. Li. 2003. Market opportunities for African agriculture: an examination of demand-side constraints on agricultural growth. Development Strategy and Governance Division and Markets, Trade and Institutions Division, International Food Policy Research Institute, 2033 Street, N.W. Washington, D.C. 20006 U.S.A.

European Communities, 2008. The World Outlook for Agricultutal Commodity Markets. MAP (Monitoring Agritrade policy).

European Communities. 2008. Labelling, Presentation and Advertising of Foodstuffs) (Amendment) Regulations. These Regulations implement Commission Directive 2007/68/EC of 27 November 2007 amending Annex IIIa to Directive 2000/13/EC of the European Parliament and of the Council as regards certain food ingredients.

FAO, 2008. FAOSTAT Accessed on http://faostat.fao.org/default.aspx in December 2008.

GTZ, 1996. Kenya soybean cook book. Ministry of Agriculture and Livestock development and Marketing. Nairobi, Kenya.

Government of Kenya, 2002. Ministry of Health: HIV/AIDS and Nutrition, Government printer, Nairobi Kenya.

Government of Kenya. 2004. Economic Recovery Strategy for Wealth and Employment Creation, Government printer, Nairobi, Kenya.

Greenberg, P. and H.N. Hartung. 1998. The whole soy cookbook: 175 delicious, nutritious, easy-to-prepare recipes featuring tofu, tempeh, and various forms of nature's healthiest bean. Three Rivers Press, New York.

Jagwe, J. and G. Owuor. 2004. Evaluating the marketing opportunities for soybean and its products in the East African countries of ASARECA: Kenya Report. International Institute of Tropical Agriculture-FOODNET.

Jagwe, J. and R. Nyapendi. 2004. Evaluating the marketing opportunities for soybean and its products in the East African countries of ASARECA, Ugandan Report. International Institute of Tropical Agriculture (IITA) *Foodnet*.

Kaara, J.W., Werner, J. and Wasike, V.W. 1998. Soybean Impact study: A case study on the small scale soyabean production, cottage processing and consumption in selected areas of Kenya. GTZ Soyabean Report 1998.

Krause, G. and V.W. Wasike. 1998. Soyabean project Kenya: Soyabean Seed Supply Survey. LUSO CONSULT GmbH, Nairobi/Hamburg, November, 1998.

Malemba 2005

Margarido M, Turolla F.A and Bueno C.R.F. 2004. The World Market for Soybeans: Price Transmission into Brazil and Effects from the Timing of Crop and Trade. Accessed in December 2008, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=616104

Misiko M, Tittonell P, Ramisch, J.J, Richards, P and Giller, K.E, 2008. Integrating new soybean varieties for soil fertility management in smallholder systems through participatory research: Lessons from western Kenya. Agricultural Systems Volume 97, Issues 1-2, April 2008, Pages 1-12.

Ohiokpehai, O and C. Osborne, 2003. Nutrition and HIV: Does eating traditional nutritious foods, including traditional fruits and high protein mixes improve the quality of life of those PLWHA. Presented at the National Research Conference on HIV/AIDS/STI other Related infectious Diseases: Providing the evidence for National Actions (Ntwa e Bolotse) 7-11 December, Gaborone, Botswana.

Osho, S.M. 1995. Soybean processing and utilization research at International Institute of Tropical Agriculture. Processing from SOYAFRICA'95: Johannesburg, South Africa, 4-5 October 1995. Association des Produits a Marche (APROMA) CEE/ACP, 52, avenue Louis Lepoutre B1060 Bruxelles, Belgique

Place, F., Murithi, F.M., and C.B. Barrett. 2005. A comparison and analysis of rural poverty between the Western and Central Kenyan highlands. Policy Brief No. 4 January 2005.

Sanginga, N., Dashiell, K. E., Diels, J., Vanlauwe, B, Lyasse, O., Carsky, R. J., Tarawali, S., B. Asafo-Adjei, B., Menkir, A., Schulz, B., Singh B. B., Chikoye, D, Keatinge, D., and Ortiz, R. 2003. Sustainable resource management coupled to resilient germplasm to provide new intensive cereal–grain–legume–livestock systems in the dry savanna. Agriculture, Ecosystems & Envirionment, 100: 305-314.

USDA, 2008. Soybeans and Oil Crops: Background. Economic Resesrch Service. Retrieved from http://www.ers.usda.gov/Briefing/SoybeansOilcrops/background in April, 2009.

Wortmann, C.S., Kirby, R.A., Eledu, C.A.and D.J. Allen. 1998. Atlas of common bean (Phaseolus vulgaris L.) production in Africa.

Appendices

Appendix 1: Some of the past and ongoing soybean projects in Kenya

Project	Period	Features and highlights	Regions/Districts	Remark
Sugar Companies (*Mumias*, Sony, & *Nzoia*)	1985 – 1996	- Introducing soybean in sugarcane-based farming systems - Aimed at increasing farmers' incomes and maximizing land utilization in sugarcane growing areas		- Mumias Sugar Company had a supply contract with EATEC (a feed processing enterprise) - EATEC bought the produce (at KShs. 22.2 ha^{-1}) for a while and close business - Limited success due unsustainable market linkages
Sigma Project	1992 – 1993	- Seed used was brought from the open market		- Not successful - Seed viability problem - Seed shattering problem - Poorly organized marketing
FAO/KAFPROD	1994 – 1996	- Strong production base - Training on utilization - Provided suitable varieties (e.g., J499) - Distribution of seed was organized through commercial channels such as Oil Crops Development (a seed merchant)	Busia, Kakamega	- Bulked about 100 t of soybean seed through farmers in 1995 and 1996 (Krause and Wasike, 1998)
IFAD/FAO/MoA	1996 – 1999	- Farmer Field School approach - Promoted production and utilization		

Project	Period	Features and highlights	Regions/Districts	Remark
AMREF	2000	- Approach was to introduce soybean to the Early Childhood Dev't Centres (ECDC) like nursery and primary schools - Promoted the use of soybean - Purchased soybean from farmers and gave to the ECDCs for purposes of training the centres on utilization - Purchased soybean at KShs. 68 kg^{-1}, well above market prices	Kwanza, Saboti, Trans Nzoia	- Was successful in creating awareness on soybean utilization among ECDC - Since it trained community representatives, the knowledge gained has been sustained in the communities - After AMREF pulled out, soybean production was stopped by farmers
Mt Elgon Initiative (funded by the government of Netherlands in collaboration with the Forest Dept, Kenya Wildlife Service & the World Conservation Union, East Africa Regional Office)	2001	- Production expansion - Creation of market linkages for farmer on the forest edges	Mt Elgon	- Effort was very limited in scope
IUCN (International Union for Conservation of Nature)	1999 – 2001	- Aimed at conserving biodiversity of Mt Elgon region, reducing conflict caused by cattle rustling between the *Luhyas* and *Saboati*, providing an alternative source of protein to dairy milk due to cattle rustling and providing income generating activity for the community - Used group [of both *Luhyas* and *Saboati*] approaches to train on soybean production and utilization	*Saboti* division in Trans *Nzoia* district	- Impacted on many members of the SDA church

Project	Period	Features and highlights	Regions/Districts	Remark
GTZ – Soybean Project (SBP)	1993 – 1998	- Implemented in two phases (1993-1995 & 1996-1998) - Target: small-scale soybean producers and cottage processors, and home utilization - Focus was on fostering the development of the whole soybeans sub-sector: variety research (develop suitable varieties for different agro-ecological zones with different soybean production potential target groups), production, processing, consumption, and marketing information - Main research work were: variety adaptive trials, germplasm acquisition, fertilizer and *rhizobium* responses, and seed bulking - Out of the 300 lines evaluated, 6 varieties (*Nyala*, Duiker, EAI3600, SCS1, Gazelle, and Sable) were recommended for release in 1998/1999 through the MoA (**Table 5**) - A manual to further support soybean extension was also planned at the end of 1998 (Krause and Wasike, 1998) - Did not fully involve agricultural extension staff (Krause and Wasike, 1998) - Used nutritional and production/marketing points of view to introduce soybean to farmers. - In areas where soybean was introduced for nutrition, many farmers continue to grow it (with some new farmers even joining). The tendency to drop soybean production after disappointing experience with marketing was more pronounced among farmers in areas where soybean was introduced from production/marketing points of view (Kaara et al. 1998)	14 districts: *Bungoma*, *Embu*, *Isiolo*, *Maragua*, *Mbeere*, *Meru*, *Nakuru*, *Kakamega*, *Busia*, *Trans Nzoia*, *Murang'a*, *Homa Bay*, *Rachuonyo*, *Kirinyaga*	- Had a Soybean Research Working Group that developed strategies to use - Helped pass seeds bulked by KARI and *Bukura* Agricultural College (BAC) to the District Agricultural Officers at a price of 30 KShs. kg^{-1} (when the commercial seed companies sold seeds to farmers at KShs. 55 – 65 kg^{-1}) - Seed bulked by above institutions met only about 40% of the seed demand by farmers - ~300 lines were screened (on in KARI stations & on private farmlands) in collaboration with NPBRC [National Plant Breeding Research Centre (Njoro)] - BAC & several large-scale farmers carried out seed bulking - HORTITEC Ltd (a commercial seed company) produced certified seed of *Nyala* for commercial purposes - Total commercial seed of soybean varieties *Nyala*, SCS1, *Duiker*, and *Tamura* produced in 1997 was estimated at 67.2 tons (Krause and Wasike, 1998) - Despite its achievements, it did not reach a self sustaining development level, a good basis for further interventions. At the time it ended, neither the public (MoA, KARI, other Ministries) nor the private sector stakeholders was prepared to continue independent of external support.

Project	**Period**	**Features and highlights**	**Regions/Districts**	**Remark**
GTZ–Soybean Project (SBP) . . .	1993 – 1998	- A 1998 review of the project recommended (i) a post care phase to focus on small-scale farmers, small-scale processors, rural and urban consumers and relevant public/private extension providers, (ii) increased focus on the nutritional benefits, small scale processing, and home utilization, (iii) increased focus on women as primary target, and (iv) concentration on agro-ecological areas and farming systems with the highest probability of adoption and self-sustained development of the sector.	14 districts: see above	- Recipe development/training workshops (127 participants from various ministries, NGOs, Church organizations, and universities and covering 24 districts) - Training on production (31 subject matter specialists from 27 districts), production of agricultural extension materials, and on the use of training materials (23 participants) - Supported the establishment of Kenya Soybean Association (KESA) and the publication of Soya News Bulletin [of the Kenyan Soya Industry) that was distributed to about 700 individuals and corporate subscribers] and consolidated a soybean database - In collaboration with the Home Economics department of the MoA, implemented 624 demonstrations on soybean utilization with 21,898 participants. No report on production extension was prepared (Kaara et al., 1998) - Between 1996 and 1998, carried out a total of 25 field days and demonstrations that attracted 8466 participants in 11 districts (*Homa Bay* 2323 participants, *Nakuru* 1701, *Bomet* 1289, *Trans Nzoia* 864, *Busia* 674, *Rachuonyo* 648, *Maragua* 398, *Mbeere* 200, *Muranga* 174, *Kakamega* 170, and *Meru* 25 participants) (Kaara et al., 1998)

Project	Period	Features and highlights	Regions/Districts	Remark
Rockefeller Foundation	2005-2009	-focuses on commercialization and marketing of soybean with special attention also to soybean productivity increase. -uses a three-tier model the addresses problems of productivity, processing and marketing at household level, community level and processing industries level -worked with federations of farmer groups and created Soybean Resource Centres (one stop shops where farmers could access soybean input/output prices information, access inputs and sell their outputs through, and be involved in various types of collective action including group processing of soybean into various products)	Three action districts: Butere, Mumias, and Migori and several satellites districts: Busia, Teso, Kakamega, Khwisero, Kisumu Rural, Bondo, Siaya, Vihiga, etc.	- productivity tremendously increased from a base of ~600 kg/ha to ~1 ton/ha with some farmers and farmers groups getting up to 1.3 tons/ha - knowledge of soybean processing using household utensils increased from a low base of about 10% to over 50% -empowered farmer groups were able to write proposals funded for them to be able to procure soybean processing machines such as *VitaGoat* and *VitaCow*. The latter processes about 960 kg of soybean into 5760 liters of milk in a month. Compared with selling soybean grains, the net returns increases associated with this ranges from 4 to 14 times -several farmer groups are now able to perform marketing functions (bulking, grading, standardization, storing, etc.) and have been supplying the large-scale processors that have agreed to clear the market (import substitution) at mutually agreed prices
Rockefeller Foundation	2005-2009	-focus is on use of soybean to address the problems of health and malnutrition including its potential benefits to People Living With HIV/AIDS	Eldoret, Suba, West pokot	-has extensively demonstrated the health and nutrition benefits of soybean -involved school feeding aspects and related research

Project	Period	Features and highlights	Regions/Districts	Remark
Bill & Melinda Gates Foundation	2008-2010	- focus is on productivity in drought-prone areas	Butere, Mumias, Migori, Teso, Busia (in Kenya)	-project is still new as we are just in the second year of the first phase -involves a lot of partners that also receive sub-grants to execute the activities agreed upon and contained in the different ToRs. -some soybean varieties (5 from KARI, 2 from IITA/TSBF) have been provisionally released during the period of this project

Source: Developed by the authors