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KENYA AGRICULTURAL VALUE CHAIN ENTERPRISES

POTATO MARKET SURVEY REPORT

Analysis for opportunities for growth in production and marketing of potatoes for processing into crisps and ready-cut frozen chips

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ACRONYMS

ADC	Agricultural Development Corporation
AFFA	Agricultural, Fisheries and Food Authority
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CIP	International Potato Centre
FAO	Food and Agriculture Organization of the United Nations
FAOStat	Statistical figures from FAO
KARI-Kenya	Agricultural Research Institute (2014 renamed to Kenya Agricultural and Livestock Research Organization-KARLO)
KEBS	Kenya Bureau of Standards
KENAFF	Kenya National Farmers Federation
KENAPOFA	Kenya National Potato Farmers Association
KEPHIS	Kenya Plant Health Inspectorate Service
KIRDI	Kenya Industrial Research and Development Institute
KNBS	Kenya National Bureau of Statistics
GIZ	German Federal Enterprise for International Cooperation
MoA	Ministry of Agriculture (2012)
MoALF	Ministry of Agriculture Livestock and Fisheries
MT	Metric Ton
NPCK	National Potato Council of Kenya
NPT	National Performance Trials

EXECUTIVE SUMMARY

Arable land in Kenya is approximately 5,500,000 hectares. Potato is produced in approximately 160,000 hectares per season representing 3 percent of the total arable land; production is mainly in two seasons per annum. As of 2014, total annual potato production was estimated to be 2.9 million MT worth about 50 billion Kenyan shillings.

More than 30 potato varieties are grown in Kenya, but relatively few are widely distributed. The dominance of certain varieties shifts over time. Potato production is mainly done by smallholders who are about 800,000 farmers. It is estimated that 83 percent of the land under potato cultivation belongs to smallholders who dedicate 0.2 to 0.4 hectares of their land to potato production. The other 17 percent of potato cultivation belong to medium and large scale farmers who dedicate 2 to 10 hectares to the crop. Average potato yields in Kenya are estimated at 7 to 10 MT per hectare compared to a global average yield of 17 MT per hectare. Low productivity in Kenya is partly attributed to limited seed related challenges and sub-optimal use of inputs.

Potatoes for processing into crisps

Dutch Robyjn and Shangi are the main varieties used in crisps processing in Kenya. However, there are three newly released varieties (Destiny, Rumba, & Taurus) suitable for crisps processing and another seven newly released varieties (Caruso, Derby, Jelly, Markies, Rudolph, Sagitta, & Toluca) suitable for both crisps and ready-cut chips processing.

Crisps processing has been carried out in Kenya for more than four decades. Information on installed capacity for crisps processing from previous studies is scanty. The survey findings indicate that the local processors are currently operating at less than 50 percent of installed capacity. The volume of potatoes going into crisps processing increased from 9,171 MT in 2004 to 35,214 MT in 2014; indicating a 14 percent annual increase in volume of potatoes processed into crisps.

The survey established that 88 percent of crisps in the market are processed locally while 12 percent is imported. Assuming the supply for potatoes for processing into crisps remains at 35,214 MT per year, Kenya will have to import 26,700 MT of crisps which is equivalent to 100,001 MT of potatoes for processing into crisps in 2024.

The study further identified two crisps processing market segments; large scale and cottage industry. The large scale industry process on average 240 MT of potatoes per month and source potatoes from contracted farmers either directly or through supply agents. Dutch Robyjn variety is the popular variety in this segment due to its good storability and high dry matter content.

The cottage industry processes on average 3 MT of potato per month and source potatoes directly from retail markets. Shangi is the popular variety in this segment partly because it is cheaper compared to Dutch Robyjn.

The large scale industry offers the greatest opportunity for development with regard to supply of raw material to substitute the imported crisps. In addition, the large scale industry has an opportunity to increase its share in the global market due to capacity to comply with international standards and existence of unutilized installed capacity. Currently, Kenya exports 6 MT of crisps per year mainly to the UK market.

This survey proposes marketing of potatoes for processing into crisps through legal farmer associations to: facilitate increased productivity through enhanced access to input credit and optimal input application; promote enforceable contract farming thus minimizing side selling; enhance compliance to harvesting

indices and postharvest handling to mitigate postharvest losses; facilitate compliance to food safety requirements such as traceability which is a mandatory requirement for supplying raw material to local fast food restaurant chains with parent companies abroad.

The quality of potato for processing into crisps is largely determined by the variety and specific agronomic requirements making supply of potato for processing into crisps a highly competitive environment. The survey determined that only 15 percent of local processors account for 85 percent of the crisps supplied to the sampled supermarkets. This is attributed to high quality requirements for the raw material. In addition, less than 50 percent of the farmers interviewed had knowledge on the quality of potatoes for processing into crisps**.**

Ready-cut chips processing

Tigoni and Shangi are the main varieties used in processing of ready-cut chips; Tigoni is preferred for ready-cut frozen chip processing while Shangi is for processing of ready-cut fresh chips. However, there are four newly released varieties (Arizona, Royal, Sarpo Mira, & Musica) for processing ready-cut chips and seven newly released varieties suitable for both ready-cut chips and crisps processing mentioned above. The survey findings indicate that length, thickness, and color after cooking were important features and attributes of the ready-cut chips. There are two forms of ready-cut chips in the Kenyan market; fresh (chilled) and frozen ready-cut chips. Ready-cut fresh chips are mainly sold as chilled to increase shelf life of the chips for up to three weeks (ready-cut frozen chips has a shelf life of up to 10 months).

The commercial processing of ready-cut chips in Kenya was introduced in 2001. However, information on ready-cut chips in Kenya is scanty. Up to 2013, Njoro Canners Limited, which closed down the line for processing ready cut chips at the end of that year, was the only registered company in Kenya processing ready-cut frozen chips with an annual output of 1140 MT.

In 2014, locally processed and imports of ready-cut frozen chips was 38.9 MT and 329.5 MT, respectively. The share of locally processed ready-cut frozen chips is expected to grow at an annual rate of 97 percent in the next 5 years. Assuming the importation for ready-cut frozen chips continues growing at the annual rate of 67 percent, the overall growth rate of ready-cut frozen chips in the local market is estimated to be 65 percent per year. Therefore, the projected quantities of ready-cut frozen chips in the local market will be 5,359 MT in 2019 and 55,155 MT in 2024. This means if the processing of locally produced ready-cut frozen chips remains at current level Kenya will rely on importation to fill the shortage of 54,015 MT in 2024.

The survey findings indicate a growing local production of ready-cut fresh chips; 2117.8 MT of ready-cut fresh chips was produced in 2014. The survey findings indicate that the market for ready-cut fresh chips grew at an average rate of 10 percent per year between 2004 and 2014. Subsequently, the projected quantity of ready-cut fresh chips in the market will be 3,441.9 MT in 2019 and 5,593.7 MT in 2024.

From the aforementioned, the Kenyan market will require 77,902.5 MT of suitable potatoes varieties to meet the 55,155.0 MT demand of ready-cut frozen chips in 2024. A further 7,900.7 MT of suitable potatoes varieties will be required to meet the 5,593.7 MT demand of ready-cut fresh chips in 2024. A total of 85,803.2 MT of suitable potato varieties will be required to meet demand for the two forms of processed ready-cut chips in 2024 or the Kenya will have to import 54,015.0 MT of ready-cut frozen chips worth over USD 129.6 million.

The survey identified four market segments for the ready-cut chips: home use; franchise hotels; and classified and unclassified hotels. The percent of the total market share of ready-cut chips for franchise hotels, home use, classified and unclassified hotels was 3 percent, 8 percent, 28 percent, and 61 percent, respectively.

The product distribution in the market was 85 percent ready-cut fresh chips, 2 percent local ready-cut frozen, and 13 percent imported ready-cut frozen chips. The survey further indicate that largest markets for various products were: unclassified hotels at 72 percent of the total ready-cut fresh chips; home use at 100 percent of total local ready-cut frozen chips; and classified hotels at 62 percent of the total imported ready-cut frozen chips.

Notable, franchised hotels use only imported ready-cut frozen chips in a bid to comply with traceability as food safety requirement.

Recommendations

- Varieties are released following successful National Performance Trials (NPT) which is conducted under circumstance often different to ordinary smallholder farm settings. In view of this, there is need for large scale commercial trials through partnership between farmers and processors of crisps and ready-cut chips to facilitate adoption of the newly released potato varieties
- Despite existence of varieties such as Dutch Robyjn, Shangi, and Tigoni that are suitable for processing of crisps and ready-cut chips, processors continue operating below the installed capacity. This is partly attributed to limited access to clean seed for the processing varieties. In review of this, there is need to develop a national seed system to ensure adequate production and efficient distribution of seed for processing varieties.
- Potato for processing into crisps and ready-cut chips have to be produced using specific agronomic requirements in order to achieve the required processing qualities. Despite the great impact on potato quality, up to 50 percent of farmers interviewed were not aware of the production and quality requirements of potato for processing. Subsequently, there is need to build capacity of farmers in recommended practices for producing potato for processing into crisps and ready-cut chips.
- The local processors are currently operating at less than 50 percent of the installed capacity. This is partly attributed to low productivity due to sub-optimal use of inputs and inconsistence supply of raw material due to reliance on rain-fed production system and lack of potato storage facilities. In view of this, there is need to organize farmers into production groups that will enhance access to inputs. In addition, there is need to promote low cost technologies such as use of Solar Water Pumps for irrigation and on-farm potato stores.
- Franchised hotels and exports offer lucrative markets for potato for processing into ready-cut chips and crisps, respectively. However, these markets demand compliance with traceability as a food safety requirement. In view of this, there is need to build a traceability system for potato for processing into crisps and ready-cut chips in order to guarantee local farmers and processors access to these lucrative markets

1. INTRODUCTION

Potato sub-sector comprises two main value chains; seed and ware potato value chains. Seed potato is sold to farmers for production of ware potato commonly referred to as table potato. Ware potato is produced for either fresh or processing market and comprises the bulk of the potato produced. There is limited importation of both seed potato and ware potato in the Kenyan market.

1.1 Potato Production

Arable land in Kenya is approximately 5,500,000 hectares. Potato is produced in approximately 160,000 hectares per season representing 3 percent of the total arable land. There are two potato crop cycles per year because of the bimodal rainfall in most potato growing areas. Previous studies indicate that only farmers from Meru County (79 percent) practice substantial off-season farming using irrigation (Kaguongo et al., 2014). In 2014, total annual potato production was estimated to be 2.9 million MT worth about 50 billion Kenyan shillings (USAID-KAVES, 2014).

Potato production is mainly done by small scale farmers numbering about 800,000. It is estimated that 83 percent of the land under potato cultivation belongs to smallholders who dedicate 0.2 to 0.6 hectares of their land to potato production. The other 17 percent of potato cultivation belong to medium to large scale farmers who dedicate 2 to 10 hectares to the crop (Janssens et al., 2013). Average production in Kenya is estimated at 7 to 10 MT per hectare compared to a global average yield of 17 MT per hectare (FAOSTAT, 2014).

More than 30 potato varieties are grown in Kenya, but relatively few are widely distributed. In 2014, Shangi and Tigoni were the most dominant varieties due to market and farmer preference. The informal seed system currently dominates the sub-sector supplying about 95 percent of the seed. However, both the formal and informal seed systems supply less than 5 percent of the national seed potato requirement (Kaguongo et al., 2010). This is attributed to limited seed production, lack of suitable varieties and insufficient distribution network for certified and clean seed potato.

1.2 Marketing

Farmers play very minimal role in marketing and activities such as pricing, promotion, and search for buyer are carried out by the local broker. Prices are set every day depending on supply and demand although sometime traders are able to influence pricing by creating artificial glut.

1.2.1 Market shares of different channels

Potato produced in Kenya is mainly consumed in major towns mainly Nairobi, Mombasa, Eldoret, Kakamega and Kisumu. The towns are mainly supplied with potato from Nyandarua, Meru, Nakuru, Narok, Bomet, Bungoma, West Pokot, Elgeyo Marakwet and Uasin-Gishu County.

Approximately 80 percent of the potato produced is sold through county markets of the major towns and local markets within the producing counties (Kaguongo et al., 2014). The rest is sold either to or through supermarkets, restaurants/institutions, and processors of various potato products.

Table 1: Percent of potato sold either to or through various markets in Kenya

Markets	Estimated proportion
County markets	80%
Supermarkets	1%
Restaurants/ institutions	10%
Processing (Include French fries, crisps, potato flour, flakes etc.)	9%
French fries	5%
Crisps and other snacks	3%
Flakes/ potato flour/ Starch	1%

Source: Kaguongo et al. (2014)

1.3 Processing

There are over 200 companies that process potatoes in Kenya. The processors can be categorized into large and cottage processors based on processing capacity. It is estimated that about 9 percent of the total potato produced in Kenya goes into processing. 5 percent of the potato that goes into processing is processed into French fries commonly referred to as chips, 3 percent goes into processing of crisps, while 1 percent goes into processing of various forms of snacks (*Kaguongo et al., 2014).* Despite many studies (Walingo, 1998; Kabira, 2003; Abong', 2011) indicating that crisps and chips consumption is growing rapidly especially due to population increase, urbanization and increase in middle income population, there is lack of data indicating the actual demand for crisps and ready-cut chips.

1.4 Study Objectives

The main objective of the study was to analyze the opportunities for growth in production and marketing of potatoes for processing into crisps and ready-cut chips. Specifically the study sought to provide an overview of market status, identify and quantify the existing market segments, describe the distribution channels, determine key product features and attributes and assess the competitive environment with regard to the market for potatoes for processing into crisps and ready-cut chips.

The study also sort to evaluate the demand growth trend in the last ten years and project future demand over the next ten years for the two potato products.

In addition, the study sought to identify product specifications for market segments with the greatest opportunity for development, propose appropriate marketing strategies to meet future demand for potatoes for processing into crisps and ready-cut chips.

1.5 Concepts and definitions

For the purposes of the current study, the following concepts and definitions are used:

i. **Potato:** Edible tuber from the plant species *Solanum tuberosum.*
ii. **Potato Crisps:** Thin slices of potato with a thickness of 1.0 to 2 mm that have been deep-fried in oil or baked until they are crunchy and light yellow to golden brown in color and usually seasoned with salt or other flavorings.
iii. **Ready-cut frozen potato chips:** These are potatoes that have been cut into strips in a "straight" or 'crinkler' manner with dimensions between 4 x 4 mm, to 13 x 13 mm. and either;
    - Washed, dried and packaged then frozen
    - Washed, blanched dried and packaged then frozen
    - Blanched, Fried in oil and packaged then frozen.
iv. **Ready-cut fresh potato chips:** These are potatoes that have been cut into strips in a "straight" or 'crinklier' manner with dimensions between 4 x 4 mm, to 13 x 13 mm. and either;

- Washed, dried and packaged
- Washed, dried, chilled and packaged
- Blanched, dried and packaged

2. METHODOLOGY

2.1 Sampling of counties and value chain actors

This study used simple random sampling and purposive sampling at different levels of value chain based on numbers, concentration and distribution patterns of actors. Where the target population (N) is greater than 10,000 the formula by Fischer's' et al. (1999) was used to determine the sample sizes.

$$n = \frac{Z^2\ pq}{d^2}$$

Where; n is the sample size for N>10,000, Z is a constant associated with the required confidence level of 95%, p is the proportion of the population expected to possess the target characteristics, q is 1-p and d is the confidence interval at 5%.

This study used 30 as the minimum sample size acceptable for each category of actors for statistical analyses (Saunders et al., 2009; Stutely's, 2003). The study used structured questionnaires which were administered face-to-face with the selected respondents by trained enumerators.

2.1.1 Sampling ware potato farmers

The farmer survey was conducted in five main potato growing counties in Kenya: Bomet, Nakuru, Nyandarua, Meru and Elgeyo Marakwet. The counties account for 60 percent of the potato produced in Kenya (National horticulture validated report, 2013). Potato varieties grown in the counties are a good representation of main varieties grown for different uses across the country. Farmers in the counties have good and practical knowledge on production, post-harvesting handling practices, and market requirements. The data collected in a previous study by Kaguongo et al. (2014) on post-harvest losses in Bomet, Nakuru, Nyandarua and Meru was used to compliment this study.

Using the formula by Fischer's' et al. (1999) the sample size was calculated using the value for p as the proportion of the potato farmers who produce potatoes for processing, which is estimated to be less than 10 percent (Kaguongo et al., 2014). The estimated minimum sample size required was 138 although this study targeted 165 farmers to cater for cases of non-responses. A minimum of 33 farmers was selected from each of the five counties to ensure compliance with the Stutely's (2003) rule of thumb.

Meru County: Most of the potato produced in Meru County is supplied to markets in Northern Kenya. The County has some farmers growing potatoes during off-season periods under irrigation. Both irrigating and non-irrigating farmers allow the crop to fully mature before harvesting. This is a characteristic that can be exploited to produce potatoes with the qualities required by processors.

Bomet County: Most of the potato produced in Bomet County is meant for processing into crisps. The county was selected to provide an understanding on production, marketing and handling practices provision of contract farming. Like farmers in Meru, Bomet farmers allow the crop to fully mature before harvesting.

Nakuru County: Most of the potato farmers in the county do not wait for the crop to attain full maturity before harvesting. The county is one of the main sources of potatoes suitable for processing into ready-cut fresh chips.

Nyandarua County: This is the largest producer of potato in Kenya. Like farmers in Nakuru, Nyandarua farmers do not allow the crop to fully mature before harvesting partly because of limited production of potato under contract farming. However, being a leading producer with vast experience, Nyandarua provide optimal conditions for testing suitability of new varieties and establishing of potato processing company. The county is one of the main source of potatoes suitable for processing into ready-cut fresh chips.

Elgeyo Marakwet: Is the second largest producer of potato in Kenya. Its high production can be explained from the fertile soils and good amounts of rainfall. This county was selected to explore the possibility of up-scaling production of processing varieties into new zones and forging of new market with processing companies.

2.1.2 Sampling of Supermarkets

The pattern of purchasing food products is similar for most of the supermarkets with produce being supplied centrally by the processor or contracted supplier on a regular basis. Purchasing of all merchandise for the main supermarkets with multiple branches is centralized in the headquarters and distribution is done to the branches on regular basis.

Ready-cut potato chips in supermarkets

Purposive sampling was used to select supermarkets that sell ready-cut potato chips. According to the Business List[1] (directory) there are 91 supermarkets in Nairobi, 23 supermarkets in Mombasa, 19 supermarkets in Nakuru and 12 supermarkets in Kisumu. Reconnaissance survey indicated that only 24 percent of the supermarkets in Nairobi and 11 percent of supermarkets in other towns stocked ready-cut chips. Fourteen of the 28 supermarkets that stocked ready-cut chips were included in the study.

Crisps in supermarkets

Consumption pattern is influenced by income levels and other socio-economic factors (Walingo *et al.,* 1997) hence supermarkets were stratified by category of income group they mainly serve i.e. high income, middle income and low income. The study targeted a sample size of 30 supermarkets that sell crisps, 10 from each category of income group, were randomly selected for the study. A total of 28 supermarkets were successfully interviewed.

2.1.3 Sampling of Processors

According to the Kenya Bureau of Standards, there are 217 registered companies that process potato crisps and ready-cut chips. However, a survey conducted by NPCK approximated that out of 217 registered companies only 40 were active processors. A total of 16 crisps processor and 9 ready-cut chips processors were successfully interviewed for this study.

2.1.4 Sampling of Hotels and Restaurants

For purposes of this study only hotels and restaurants that used ready-cut potato chips were selected. According to The Ministry of East African affairs Commerce and Tourism there are 1,581 registered hotels and restaurants in Nairobi (436 hotels and 1,145 restaurants). A sample of 390 hotels and restaurants randomly selected and interviewed showed that only 5 percent of them used ready-cut potato chips.

A sample size of 30 hotel and restaurants were involved in the study. A stratified sampling was used to ensure different classes of hotels and restaurants were included in the study. Since consumption practices of chips are closely related to different standards and levels of wealth, hotels sampled in the study were placed into three categories: five star (5), three star (5) and standard hotels (5). Similarly, restaurants

[1] http://www.businesslist.co.ke/kenya-business-search/1

sampled in the study were stratified into international chain (5), local upmarket (5) and local standard restaurants (5).

2.1.5 Sampling of Consumers of Chips and Crisps

Consumers of crisps and chips were randomly selected from the points of purchase or consumption and were stratified to ensure the three income groups are covered. For crisps, consumers were selected from supermarkets while consumers of chips were selected from hotels and restaurants. Consumers provided information about individual and/or household chips and crisps consumption patterns and eating habits of different cohorts in their families.

The sample size for consumers of chips and crisps was calculated using formula by Fischer's' et al. (1999), where p is the proportion of chips consumers, which was estimated at 10 percent based on Kaguongo et al. (2014) and experts' opinion. The estimated minimum sample size was 138 hence 150 consumers were sampled to take care of spoilt questionnaires which is likely with consumers who are often impatient.

3. POTATO FOR PROCESSING INTO CRISPS

3.1 Background to Crisps Processing in Kenya

Crisps processing has been carried out in Kenya for more than four decades. The earliest documentation of crisp processing was done by Durr and Lorenzl (1980). By then, there were a total of five crisp processors with the largest factory processing about 20 tons of fresh potatoes per month, while the other four altogether processed a total of 20 tons per month. In 1995, there were at least 22 processors with an average production of 61 tons per month while in 2003, the number of crisp processors was estimated at 40 with the highest concentration of potato processors being in Nairobi city and consuming about 2 percent of the total potato production in Kenya (Walingo et al., 2004). The number of crisp processors is believed to be much high than is usually reported. This is partly because cottage processors who form the bulk of the crisp processors may not be registered and do not brand their products and hence it may be difficult to establish the actual number of processors in this informal sector (Kirumba et al., 2004).

Currently, local crisp processors operate below installed capacity. This is attributed to limited availability of suitable potato varieties, low yield due to sub-optimal application of inputs, poor crop husbandry leading to low quality potato for processing, and dependence on rain-fed production system among others. Dutch Robjyn, the round and red-skinned, is the most popular potato variety in Kenya for processing crisp (Kabira, 2002). Among the desirable qualities of potato for processing crisp include size, shape, flesh color, reducing sugar and dry matter content. Potato varieties grown and marketed in Kenya for processing into crisps are very few and are faced with the challenge of susceptibility to diseases and poor yields (*Annex 1*).

3.2 Farming and Marketing

3.2.1 Famer characteristics and potato farming

Farmers mostly obtain seed potato from other farmers or local markets; there are few farmers that obtain seed potato from the few seed producing and multiplying institutions. Most potato farmers lack the necessary skills and adequate and appropriate inputs to produce potato meeting requirements for crisp processing. A high percentage of farmers harvest potatoes before attaining maturity especially prior to the main harvesting period in a bid to obtain high prices associated with scarcity of potato. Generally, farmers' rate of adoption of new technologies and innovations is low mainly due to lack of awareness, affordability and resistance to change.

Age and education is known to have an impact on openness to change and innovation and on the commercialization of agricultural production. Farmers with higher levels of education tend to be more efficient in production. Better performance by educated farmers may be attributed to ability to perceive, interpret and respond to new information and improved technology such as fertilizers, pesticides and planting materials much faster than their counterparts (Nyagaka et al., 2009).

The average age of sampled farmers was 44 years (Table 2). Elgeyo Marakwet had the youngest farmers (37 years). Bomet County had farmers with the highest levels of literacy, with 79 percent having completed secondary and tertiary education. The high literacy level may have contributed to high percentage of farmers willing to enter into contract farming, using good agricultural practices and adopting processing variety in Bomet. Elgeyo Marakwet on the other hand had the highest percentage of farmers with university/college education (29 percent) followed by Bomet County (24 percent).

Table 2: Farmer characteristics and land holding

	NAKURU n=33	BOMET n=33	NYANDARUA n=33	MERU n=33	E. MARAKWET n=33	All n=165
Age of farmers (years)						
Mean	43.3	43.1	50.3	49.0	37.0	44.5
Std. Dev.	13.6	9.2	12.5	13.9	9.3	11.9
Education level of farmers (%)						
Primary	36.4	21.2	36.4	40.6	47.1	36.3
Secondary	36.4	42.4	36.4	53.1	20.6	37.8
A Level	3.0	12.1	12.1	0.0	2.9	6.0
College/University	21.2	24.2	9.1	3.1	29.4	17.4
Total land size (Ha)						
Mean	1.6	1.4	1.9	1.5	2.7	1.8
Std. Dev.	1.0	1.2	1.6	1.3	1.9	1.4
Land under potato (Ha)						
Mean	0.7	0.8	0.7	0.4	0.7	0.7
Std. Dev.	0.3	0.3	0.4	0.2	0.4	0.3
Yield/ha						
Mean	14,950.3	13,243.8	13,629.4	11,888.6	8,432.3	12,428.9
Std. Dev.	12,543.4	11,645.6	10,143.9	10, 766.7	9,255.2	10,931.0
Irrigated potato production (%)	8.7	0.0	2.7	79.2	3.8	18.8

Source: USAID-KAVES Potato survey, 2014

3.2.2 Land holding and production methods

Land holding averaged 1.8 hectares in the five counties with an average yield of 12,428.8 Kgs/ha. The average land under potato production was 0.6 hectares. The study findings indicated that every county had a dominant potato variety grown. In Bomet, 96 percent of producers were growing Dutch Robyjn while 99 percent of producers in Nakuru were growing Shangi, 100 percent of producers in Nyandarua and 64 percent in Elgeyo Marakwet were growing Shangi. In Meru, 79 percent of producers were growing Asante (Table 3).

Use of certified seed is important in improving quality and quantity of potato supplied for processing in Kenya. The study findings indicated that Bomet County had the highest number of farmers (30 percent) reporting having used certified seed potato. Elgeyo Marakwet was the least, with no farmer reporting having used certified seed. Majority of farmers interviewed (92 percent) use seed obtained from informal seed system.

Farmers practicing contract farming in Bomet County cited consistency of price and assured market as the major benefits of the arrangement. However, farmers and processors under contract farming arrangement were faced with several challenges, with fulfillment of obligations in the contract. Farmers have accused processors of deducting higher prices of the inputs provided on credit by processor compared to market prices and hence make profits at the expense of the farmer. In other instances the quality of seed provided has been called into question. Contracting processors on the other hand have cited farmers breaching their contracts once the produce is ready and market prices are higher than the contract price and sell the produce to other buyers (Maingi, 2014).

Table 3: Potato Production

	NAKURU n=33	BOMET n=33	NYANDARUA n=33	MERU n=33	E. MARAKWET n=33	All n=165
Potato variety grown by farmers (%)						
Dutch Robjin	2.9	96.2	0.0	0.0	2.1	20.2
Sherekea	5.9	0.0	23.3	50.9	0.0	16.0
Shangi	98.5	30.8	100	49.1	64.6	68.6
Tigoni	7.7	3.8	38.4	0	29.2	15.8
Tigoni red	0.0	0.0	0.0	52.8	0.0	10.6
Asante	5.9	0.0	6.8	79.2	0.0	18.4
Others	5.2	12.9	11.1	14.6	4.2	9.6
Farmers who have had Access to extension on potato production (%)	33.3	81.8	72.7	78.1	18.2	56.7
Farmers practicing crop rotation (%)	92.8	100	91.7	100	58.0	88.5
Pre-harvest and harvesting practices (%)						
Dehaulming	52.3	86.3	22.4	56.3	27.0	48.9
Harvest with fork Jembe/Hoe	73.9	3.8	98.6	56.6	100.0	66.6
Potato marketing (%)						
Farmers who had ever engaged in Contract farming	6.3	45.5	15.6	9.4	2.9	15.9
Farmers who Sorted and graded potatoes for sale	6.1	93.9	12.0	21.9	8.8	28.5

Source: USAID-KAVES Potato survey, 2014

Pre-harvesting and harvesting practices

Preparations of potatoes for harvest determine the quality of tubers supplied to processors. The study findings indicate that only 49 percent prepared potatoes for harvesting by dehaulming. This is an indication that high proportion of potatoes in the market may not be properly cured lowering their quality during marketing and processing.

The tools used for harvesting are also a major cause of damage lowering the quality of marketed potatoes. According to Kaguongo et al. (2014) 93 percent of farmers experience damage caused by poor pre- and post-harvest management practices and tools used to harvest potatoes. Majority of farmers (67 percent) used Hoe and Fork Jembe.

3.2.3 Potato Marketing

Contract farming is a key aspect in processor-farmer integration and it improves potato production in two ways; Farmers have a ready market hence are willing to invest more in inputs thus are able to improve both quantity and quality of potatoes. The processor is also able to get raw material that matches his needs hence produce crisps that match the market demand. The study findings indicate that only 16 percent of farmers interviewed stated having ever engaged in contract farming, with highest proportion of farmer (46 percent) coming from Bomet County and lowest proportion (3 percent) coming from Elgeyo

Marakwet County. Farmers practicing contract farming in Bomet County cited consistency of price and assured market as the major benefits of the arrangement.

The survey findings indicate that only 29 percent of the farmers sort and grade potato before marketing. Bomet at 94 percent had the highest number of farmers that sort and grade before marketing potato; while Nakuru at 6 percent had the least number of farmers that sort and grade potato before selling. Farmers who sorted and graded potatoes cited high prices and requirements by the processors as the main reason for the practice. Low percent of farmers engaged in contract farming was attributed to lack of interest on the part of the processors who cited failure to recoup investment in terms of inputs supplied to farmers caused by side selling.

3.2.4 Crisps processors

Majority of processors (81 percent) did not have adequate supply of potatoes for processing. Although majority (75 percent) of cottage processors stored potatoes possibly due to their low processing capacities, the large processor did not store. The high cost of storage facilities was the main reason cited for lack of store.

Only 25 percent of processors had some form of traceability which was limited to tracking suppliers of potatoes. The limited traceability is attributed to lack of suitable legal framework that provide for mandatory registration of all potato dealers and integration of information system among the relevant regulatory agencies.

3.3 Key product features and attributes

The tastes and preferences of Consumers are important aspects that processors consider when determining the specifications for the potatoes they source for processing. Ninety-three percent of consumers consider crunchiness as a very important attribute of good crisps while 64 percent prefer crisps that are very crunchy. Eighty-two percent of the respondents indicated that they prefer non-broken crisps while 72 percent cited crisps color as an important attribute of crisps. Slightly more than half of consumers (53 percent) preferred crisps with golden brown color (Table *4*).

Table 4: Features and attributes preferred by consumers of crisps

Features and attribute	Crunchiness	Color	Non-broken	Thickness
Preferred feature/attribute (%) (n=150)	92.5	72.3	81.8	42.2
Specific attribute	Very crunchy (n=135)	Golden Brown (n=106)	Complete (n=120)	Slim (n=62)
Preferred specific attribute (%)	64.4	52.8	100	51.6

Source: USAID-KAVES Potato survey, 2014

According to the processors interviewed characteristics of good potatoes for processing include; round shaped and medium sized tubers (between 40 and 60 mm) with shallow eyes; medium sized tubers and shallow eyes allow uniform cutting, especially with machine cutting (Walingo et al., 2004), high dry matter content (20 to 25% of fresh weight) and low quantities of reducing sugars (0.01% to 0.15% of fresh weight) (Table 5). These attributes are influenced by growing conditions thus the need for farmers to have access to effective extension services.

Table 5: Important features and attributes for processors (%)

Feature/ attribute	Large scale n=4	Cottage n=12	All n=16
Potato size (Medium size)	100.0	75.0	81.3
Potato shape (Round)	100.0	25.0	43.8
Eye depth of potato (Shallow)	100.0	25.0	43.8
Dry matter content (High)	100.0	50.0	62.5
Sugar content (very low)	100.0	58.0	68.5

Source: USAID-KAVES Potato survey, 2014

The study findings indicated that only 48 percent of the sampled farmers stated knowing the attributes for a good potato for crisps processing. Bomet County had the highest number of farmers (64 percent) who stated knowing the suitable attributes for potatoes for crisping potatoes while Elgeyo Marakwet had the least number of farmers (15 percent). However, only 48 percent of the farmers mentioned high dry matter content as being important for crisps processing. Only 10 percent cited shallow eyes, 16 percent cited round shape while 6 percent cited *"No darkening"* which is a proxy for low reducing sugars *(Table 6)*.

Table 6: Farmers' knowledge on crisps processing attributes

	Nakuru n=33	Bomet n=33	Nyandarua n=33	Meru n=33	E. Marakwet n=33	All n=165
Farmers who said they knew the attributes for potatoes for processing (%)	57.6	63.6	57.6	46.9	14.7	47.9
Potato processing attributes cited by farmers (%)						
	Nakuru n=19	**Bomet n=21**	**Nyandarua n=19**	**Meru n=15**	**E. Marakwet n=5**	**All n=79**
High dry matter	15.8	81.0	47.4	100.0	20	57.0
Shallow eyes	31.6	0.0	10.5	0.0	0	10.3
Round shape	10.5	4.8	36.8	14.3	0	15.6
No blackening	0.0	19.0	5.3	0.0	0	6.4
Other wrong attributes sited (big size, white skinned, etc.)	47.4	23.8	26.3	7.1	100.0	32.1
Potato varieties mentioned by farmers as suitable for crisps processing (%)						
Dutch Robjin	0.0	86.4	5.3	23.1	0.0	28.6
Sherekea	5.3	0.0	5.3	30.8	0.0	8.4
Shangi	78.9	4.5	57.9	0.0	60.0	37.9
Tigoni	10.5	4.5	26.3	7.7	20.0	12.8
Asante	0.0	0.0	0.0	38.5	0.0	7.3
Others	5.3	4.6	5.2	0.0	20.0	5.0

Source: USAID-KAVES Potato survey, 2014

3.3.1 Influence of attributes on price

Despite being low yielding and susceptible to pests and diseases, Dutch Robyjn is the most popular variety in Kenya for processing potato crisp due its high dry matter content (above 20 percent), low sugar content (below 0.15%) high gravity (not less than 1.080) and good storability. Other attributes desirable for processing include: size (between 40 mm and 55 mm in diameter), round in shape with shallow eyes, and free from solanine, bacterial wilt, soft rot, and sprouts. Processors observed that Dutch Robyjn grows well producing the aforementioned attributes only in Bomet County. Processors further reported that other than Taita Taveta, Dutch Robyjn on-farm trials have failed to produce similar processing qualities in other potato growing counties. This is the main reason why Bomet County had higher potato prices compared to other counties (Table 7).

Table 7: Prices of potato in different Counties

Farm gate price (KES/ Kg)	Nakuru n=33	Bomet n=33	Nyandarua n=33	Meru n=33	E. Marakwet n=33	All n=165
Highest Price	19.8	24.2	15.2	18.5	10.0	17.5
Lowest Price	8.8	12.2	7.3	10.3	7.2	9.2

Source: USAID-KAVES Potato survey, 2014

3.4 Market segments

3.4.1 Identification of market segments

This study used multiple bases of market segmentation included operating variables (infrastructure, technology) purchasing approaches (Purchasing behavior of raw material, relationship with suppliers), facilities/equipment set up for potato processing, specifications of raw material they require, and standards applied in processing. The following are the derived market segments for potatoes for processing into crisps (Hsu and Powers, 2002; Kotler et al., 2009; Christall, 1985)

3.4.1.1 Large scale processors

Companies that fall into this market segment are very specific in quality and standard requirements for the potatoes they purchase. The specifications are based on variety type, size, shape, dry matter content and reducing sugar content and reject potatoes that do not fit these requirements. The companies in this group purchase potatoes either directly from contracted farmers or from agents who bulks potatoes from different farmers and then deliver to their premises. This category also applies international processing standards since they also export the crisps. Companies in this segment have modern automated machinery which may include washing and destoning, abrasive peelers, automated slicers, and blanchers, fryers, flavouring units, packaging machines, and employ more than 20 experts and skilled employees. Individual companies under this segment process more than 5 MT of potatoes per day.

3.4.1.1 Cottage processors

Companies in this segment may have specific requirements in terms of the potato they use in processing though they do not strictly follow these requirements. They purchase potatoes in small quantities from retail markets by themselves and therefore do not have any interactions with farmers. Processor in this category may not apply any standards in their processing and most of their product is sold within their locality. These companies do not have standard premises and processing infrastructure. Some parts of processing that include washing, peeling, slicing and packaging is done manually, while frying is done on open fire made using firewood or charcoal. They do not employ experts and usually use locally fabricated processing equipment. Companies under this category process less than 5 MT of potatoes per day and have less than twenty employees.

3.4.2 Quantification of market segments

Quantification of the market segments was based on potatoes that were processed into crisps.

Table 8: Quantification of market segments

Market Segment	Large scale processors (n=4)	Cottage processors (n=12)	All (n=16)
Total potato processed (MT/year)			
Mean	2,640	33.1	685
Std. Deviation	1,496	15	1057
Total crisps production (MT/year)			
Mean	708	8.2	183
Std. Deviation	412	4.4	291
Yield of crisps %			
Mean	26.8	24.8	25.3
Std. Deviation	3.0	3.0	3.0

Source: USAID-KAVES Potato survey, 2014

The study findings indicate that the large scale processors processed an average of 2,640 MT of potato per year and produced an average of 708 MT of crisps. This translates to a yield of 27 percent. Comparatively, the cottage segment process an average of 33.1 MT of potato per year and produces an average of 8.2 MT of crisps per year translating to a yield of 25 percent (Table 8).

A recent study by Maingi (2014) indicated that there are 40 active crisps processors in the country. Based on the KEBS categorization and characteristics of processing companies and data obtained from the field, processors were grouped into 13 large scale processors and 27 cottage processors. The total annual requirement for potatoes for processing into crisps was estimated to be 35,214 MT per year (Table 9).

Table 9: Quantities of potato processed into crisps in 2014

	Large scale processors	Cottage processors
Average quantity of potatoes required per processor (MT/month)	220.00	2.76
Number of processors	13	27
Total quantity of potatoes (MT/month)	2,860.00	74.52
Total potatoes requirement per year (MT/Year)	34,320	894.24

Source: USAID-KAVES Potato survey, 2014

According to Abong (2011), 60 percent of processed crisps are sold through the supermarkets. The sampled supermarkets sold a total of 2,736 MT per year of potato crisps. Of this quantity, 2,345 MT was supplied by the large scale processors, representing 86 percent while 49 MT was supplied by the cottage processors, representing 2 percent. The remaining 342 MT representing 13 percent was imported. This shows the large scale processors dominate the crisps market.

3.5 The distribution channels

Majority of potato processors are based in major towns with Nairobi accounting for the largest share of registered processors (85 percent). Dutch Robjyn-the potato variety most preferred for crisps processing- is mainly grown in Bomet county. About 81 percent of the marketed produce from Bomet County is sold in Wakulima Market of which 65 percent goes to crisps processing (Janssens et al., 2013). The study findings indicate that majority of farmers (90 percent) sold their produce at the farm gate where 56 percent sold through the local brokers and 32 percent directly to traders (Table 10 and Figure 1).

Table 10: Marketing of potatoes by farmers

Bomet is the only county with farmers (21 percent) selling their produce directly to processors. It is also the county with the least farmers (15 percent) selling to brokers. Majority of Elgeyo Marakwet farmers (94 percent) sell their produce to brokers (Table 10).

	Nakuru n=33	Bomet n=33	Nyandarua n=33	Meru n=33	E. Marakwet n=33	Total n=165
Location where farmers mostly sell their potatoes %						
Farm gate	87.9	81.8	90.9	93.8	94.1	89.7
Local market	6.1	6.1	6.1	3.1	5.9	5.5
Collection point	6.0	12.1	3.00	3.1	0.0	4.8
Person to whom farmers mostly sell their potato %						
Broker	69.7	15.2	57.6	43.8	94.1	56.1
Local trader	9.1	60.6	30.3	53.1	5.9	31.8
Wholesaler	21.2	0.0	12.1	0.0	0.0	6.7
Processor	0.0	21.2	0.0	0.0	0.0	4.2
Hotel/other outlets	0.0	3.0	0.0	3.1	0.0	1.2

Source: USAID-KAVES Potato survey, 2014

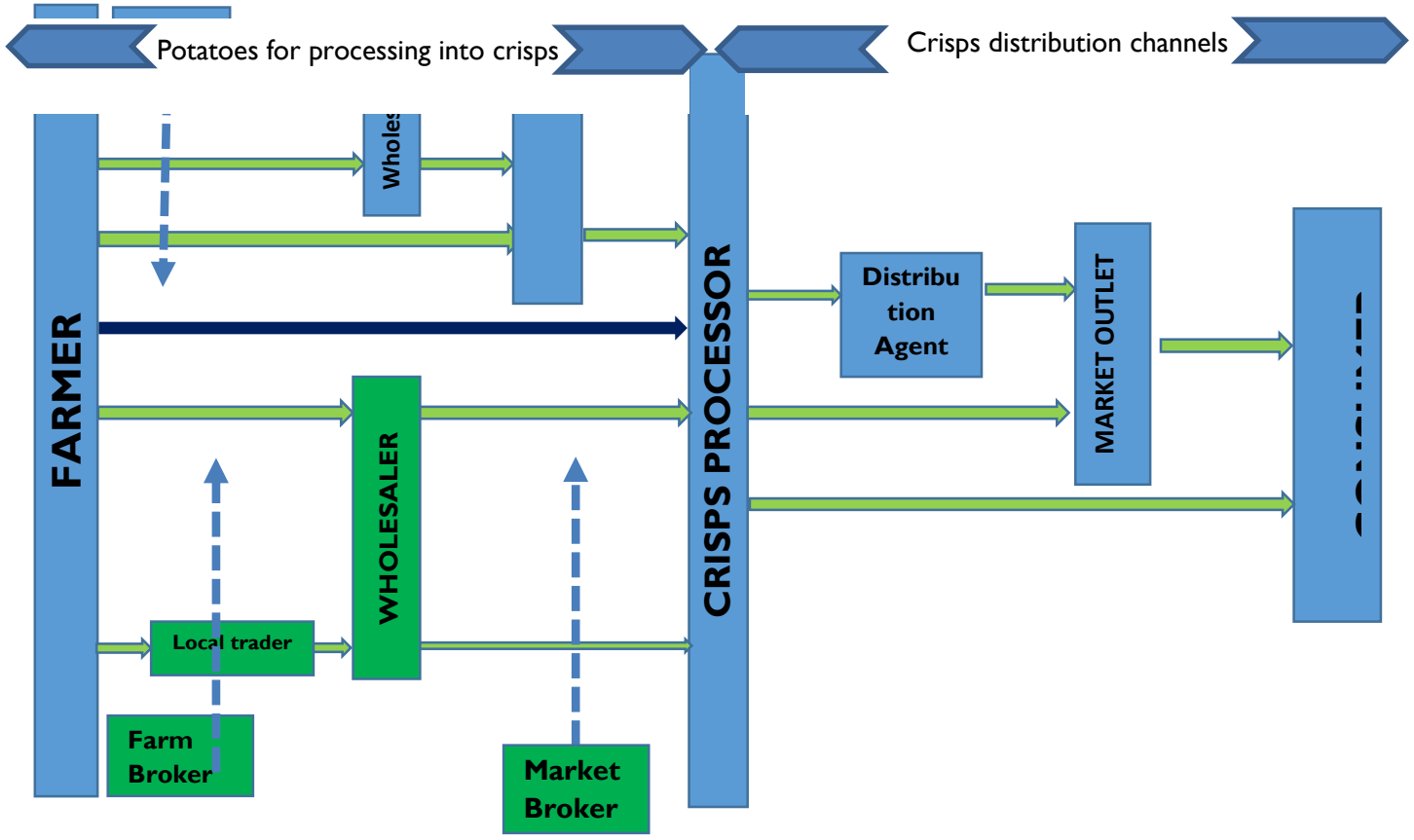


Figure 1: Distribution channels

The survey findings indicate that large scale processors source potatoes directly from farmers or through a supply agent. This partly guarantees both quality and supply as opposed to sourcing the potato from the local markets. Most of cottage processors buy their potatoes from supply agents (58 percent) and also bought directly by themselves from local markets (78 percent) (Table 11). This is because their daily demand coupled with little storage capacity makes it untenable for most of them to source potatoes directly from farmers.

Table 11: Sources of potato for processing

Sources of potato for processing	Large n=4	Cottage n=12	All n=16
Person supplying potatoes to processors (%)			
Supply Agent	100.0	58.3	68.7
Farmers	100.0	16.7	37.5
Self-sourcing	0.0	83.3	62.5
Where potatoes are sourced from (%)			
Market	0.0	77.8	58.4
farm gate	100.0	66.7	75.0
collection centre	100.0	11.1	33.3

Source: USAID-KAVES Potato survey, 2014

3.6 Competitiveness

The study findings indicate that 85 percent of the crisps sold by sampled supermarket are supplied by only 6 processors, an indication that these are the main companies competing for the potatoes for processing into crisps. Potato crisps processing is highly competitive partly because of limited supply of raw material. Dutch Robjyn is the only suitable locally cultivated variety. The variety is low yielding and highly susceptible to pest and diseases. Due to limited supply, Dutch Robjyn is highly priced thus only affordable to large scale processors. The high external and internal specifications of potato for processing into crisps require precise climatic conditions and optimal application of the right inputs including fertilizers. This makes the large processors more competitive compared to cottage processors who use alternative varieties that do not meet the processing specifications. Use of varieties which are unsuitable for processing lead to production of crisps of poor quality (blackening, non-crunchy, broken etc.,) making cottage processors uncompetitive especially in high end market outlets.

The need for traceability in the international market makes potato crisps processing very competitive. Franchise food stores insist on using crisp potatoes that are fully traceable in line with the international food safety requirements. Therefore introduction of a traceability system in the industry would improve the competitiveness of the large processors both in the country, region and international markets. The increased competitiveness of the large scale processors could help reduce the share of imported crisps in the Kenyan (12 percent) and regional markets especially because the prices of imported crisps are highly affected by exchange rate.

The machinery used by cottage processors lead to production of crisps of low quality that are non-uniform and broken lowering the competitiveness of the cottage industry. Large initial capital investment costs in crisps processing plants are a major barrier to entry for new entrants, especially in large scale segment.

3.7 Demand growth in the last ten years

3.7.1 Demand for Potatoes for processing into Crisps

Potato crisps consumption is the major driver of demand for potatoes for processing into crisps in Kenya. This is known as derived demand where potato farmers don't experience retail demand, but instead they experience farm-level demand which is the demand for potatoes by the crisps processors (Pride and Ferrell, 2012).

According to Kirumba et al. (2004), the volume of potatoes going into crisps processing increased by more than two folds from the year 1996 to 2003. KARI (2004) estimated that 3,660 MT of potatoes were processed in 1996 yielding 732 tons of crisps. In 2003, 8,176 tons of potatoes were processed yielding 1,635 MT of crisps this represents a 123 percent increase, which translates to an annual growth rate of 12.2%[2].

According to Kaguongo et al. (2014), 71 percent of the potato produced in Kenya is marketed while 3 percent of the marketed potato is used to produce crisps and other snacks. With the marketing losses of up to 9 percent of the quantity of potatoes that went into crisps and other snacks processing in 2013 was estimated to be 41,105 MT (Table *12*).

[2] CAGR = $(EV / BV)^{1/n} - 1$
where:
EV = Ending value
BV = Beginning value
n = Number of years

Table 12: Quantities of potatoes used for processing into crisps in 2013

	Potatoes (MT)
Total quantity of marketed potatoes	1,505,700
Quantity of potatoes going to crisps and other processing	45,171
Losses due to rejects (9%)	4,065
Total quantity of potatoes going to crisps and other snacks processing	41,105

Source: Kaguongo et al. (2014)

The survey findings indicated that the annual demand for potatoes for processing into crisps by the large scale and Cottage processors in 2014 was 35,214.2 MT (*Table* 13) **Table *12***. This is comparable to the estimated 41,105 MT for production of crisps and other snacks in 2013 (Kaguongo et al., 2014) and estimate of 33,076 MT projected from past data (Kirumba et al., 2004; KARI, 2004).

Table 13: Total demand for potatoes for processing into crisps in 2014

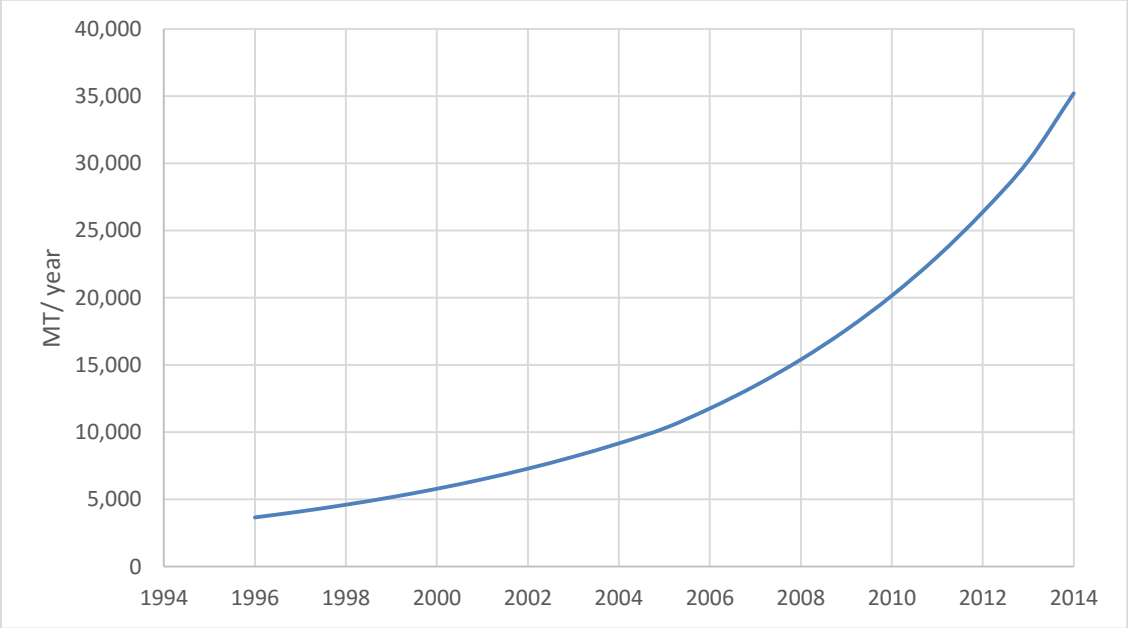
	Large segment (n=4)	Cottage segment (n=12)
Average quantity of potatoes processed per processor (MT/ year)	2,640.0	33.1
Number of processors	13	27
Total annual demand for potatoes for processing into crisps (MT/year)	34,320.0	894.2

Source: USAID-KAVES Potato survey, 2014

3.7.2 Projection of future demand

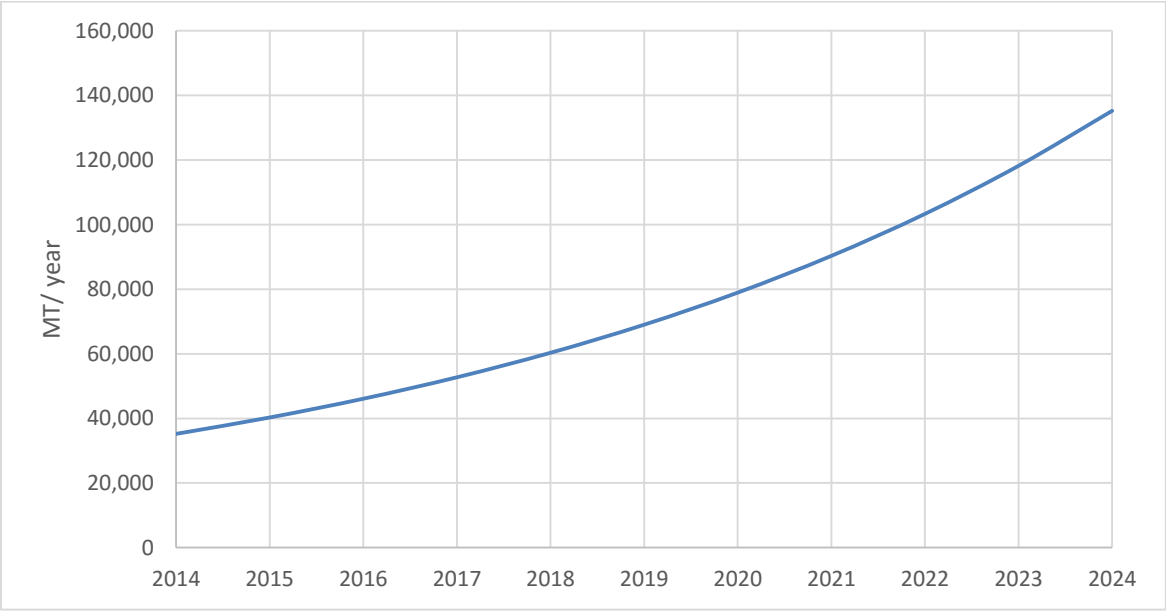
The demand growth trend for potatoes for processing into crisps in the next ten years (2014-2024) was estimated using the annual growth rate in demand for the period 2004 -2014. Based on data from previous studies, it is estimated that in 2004, the total demand for potatoes for processing into crisps was 9,171 MT (**Error! Reference source not found.**).

Figure 2: Growth in quantities of potatoes used for processing into Crisps



The estimated demands for potatoes for processing for 2004 and 2014 were used to calculate the growth rate of 14 percent per year which was used for projection. Therefore, the total demand for potatoes for processing into crisp in 2019 is estimated to 69,000 MT while in 2024 it is estimated to be 135,200 MT (**Error! Reference source not found.**). However, a slightly higher demand is expected as a result of ncreased urbanization and growth of cottage industries which the country is experiencing.

Figure 3: The demand growth trend in the next ten years



3.7.3 Challenges in supply and demand for potatoes for processing into crisps

A major challenge facing processors is the shortage of suitable potato varieties for processing into crisps. Currently, there exists only one preferred variety (Dutch Robjyn). Adoption rates of processing varieties by farmers is low due to lack of certified and/or clean seed and the low yielding nature of the crisp processing varieties. Another constraint is the fluctuation in supply due to the rain fed nature of potato production in the country. This leads to periods of gluts and scarcity and therefore surges in prices which at times discourage production. Due to lack of production and marketing standards as well as low levels of adoption of good agricultural practices by farmers the quality of produce is poor resulting in low quality products, high production and processing wastes or total rejection of potatoes by processors.

3.8 Product specifications and market segments with greatest opportunities for development

The large scale segment require potatoes with the right range of dry matter content (20 - 25%) and reducing sugars (0.01 - 0.15%) to ensure the preferred crispiness and color of crisps respectively. If the dry matter content is too low, the crisps become too soft or too wet. In addition, more energy is utilized in processing since more water must be evaporated from the potato leading to high processing costs. High dry matter concentration on the other hand results in a lower fat content which is preferred by health conscience consumers. However, too high dry matter content lead to production of brittle crisps with high breakage.

Size, shape and eye depth of potato tubers is another specification that processors in the large scale segment look for in potatoes used to process crisps. Shallow eyes are preferred to deep eyes as the latter leads to high peeling losses since the potato has to be cut deeper to attain a smooth surface. Oblong shaped potatoes produces crisps of wide ranging sizes hence increase the rate of rejects. Round tubers of a size range of 40-60 mm are ideal for producing appropriately sized slices

3.9 Proposed marketing strategies for potatoes for processing into crisps

3.9.1 Product strategy

Participatory breeding and introduction of new varieties: Although other varieties like purple gold (Onditi et al., 2012), Caruso, Rumba and Jelly (Potato Variety Catalogue, 2015) were recently released and introduced for crisps processing, market feedback from processors in stakeholder meeting[3] indicate that they are yet to be available in the right amount. Some of the recently introduced varieties are also showing inconstancies in attributes suitable for crisps processing. To meet the growing demand for potatoes for processing it is imperative that the country improves on the existing breeding programme and regular introduction and adoption of new potato processing varieties. More importantly, the crisps processors and farmers should be involved in a participatory breeding and trials for successful development, selection and adoption of suitable varieties. Awareness creating of the newly released varieties and linkage of farmer and farmer groups to processors would facilitate adoption.

Quality improvement: Farmers hardly sort and grade potatoes hence processor receive supplies with mixed varieties, cut and bruised tubers, oversized/undersized tubers and greening, rotten and sprouting tubers. This might be attributed to lack of knowledge by farmers on the quality specifications requirement as shown by this study's findings and lack of premium for quality aspects. Awareness creation, introduction of quality control methods, price differentiation for better quality tubers and introduction of alternative use for rejected tubers such as baby tubers would improve the quality of potatoes supplied to processors.
Improve consistency and quantity supplied: Potato production in Kenya is mainly rainfall dependent, leading to peaks in quantities during harvest which gradually reduces to a point of scarcity before the next

[3] Seed stakeholder meeting held at KALRO headquarters on 21st May, 2015

harvest. The study findings indicate that only 32 percent of farmers' stored potatoes intended for sale. Production of potato under irrigation and storage would help improve availability of potatoes during the off season periods. There is therefore a need to promote adoption of low cost potato storage facilities, development of irrigation system and evaluate possibility of introducing warehouse receipting system.

Standardization units of marketing: The potato industry in Kenya has lacked marketing standards with the packaging potato bags vary from 130 to 260 kgs per bag. Although the national and county governments have started enforcing regulation limiting maximum packaging weight of 50 kg market compliance is still low.

Packaging material: The material used for potato packaging must allow removal of metabolic heat and protect the tubers from ultra violet light, pathological, physiological and/or mechanical damage during storage and transport. Nylon bags although unsuitable are commonly used for packaging due to high cost of jute and sisal bags which are recommended. Concerted effort is therefore needed to ensure availability of suitable packaging materials at competitive prices.

Health aspects: Alternative recipes for making crisps such as fat free oven baked crisps or low calorie, low cholesterol; low/no salt crisps should be encouraged for the health conscious consumers. There is also need to monitor use of inputs such as herbicides and pesticides as well as introduce traceability, which is currently not well embraced in the potato sub-sector.

4. READY-CUT CHIPS

There are two broad forms of ready-cut chips in the Kenyan market; fresh and frozen. Ready-cut fresh chips may be chilled or blanched to increase the shelf life to at least 21 days; read-cut frozen chips has a shelf life of at least 10 months.

Processing of ready-cut frozen chips in Kenya was pioneered by Njoro canning limited in 2001. Other than locally processed, the survey findings indicate that Kenya import ready-cut frozen chips mainly from the Netherlands and to a limited extend from Egypt and South Africa. The survey findings indicate that at present there is no commercial production of ready-cut frozen chips in Kenya. However, ready-cut fresh chips production is vibrant through large scale and cottage processors.

4.1 Potatoes for processing into ready-cut chips

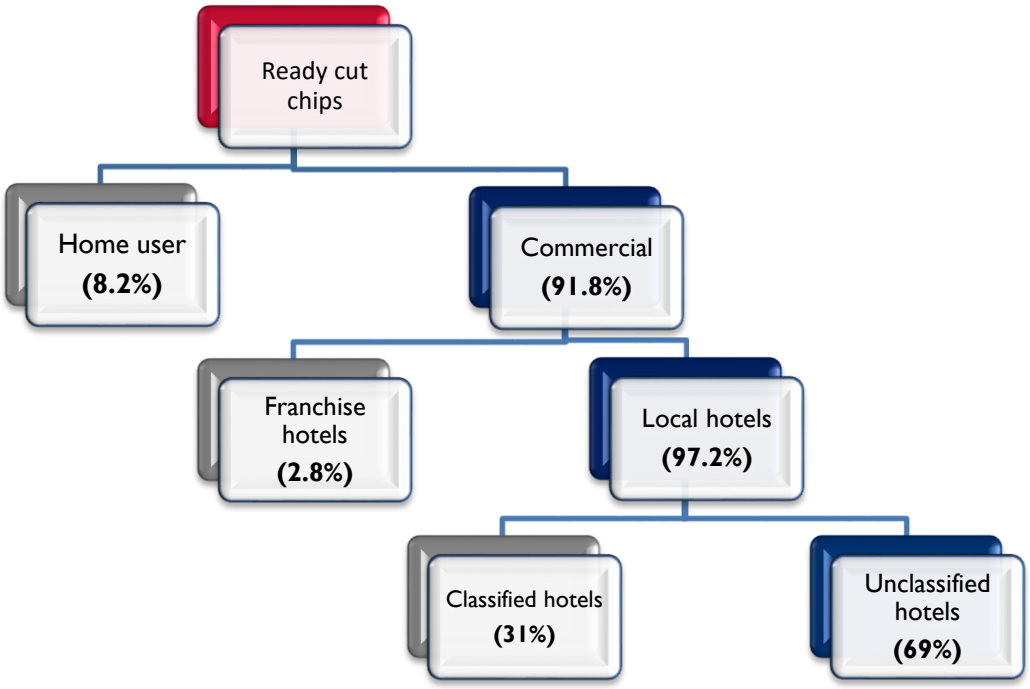
Most of the potato varieties grown in Kenya are not of the required quality and standards for processing ready-cut frozen chip (Tesfaye *et al.*, 2010). The only available variety that is suitable for processing into frozen chips is Tigoni. The variety is consistent in taste, color and texture in frozen state (Maingi, 2014). Although Tigoni is the most preferred variety for ready-cut chips processing, all processors interviewed were using Shangi. The popular use of Shangi is mainly due to reliable supply rather than the quality of chips. Shangi is a high yielding and a short maturity variety. Generally, processors are operating below installed capacity with the leading processor hardly processing 120 MT per day despite the installed processing capacity of 300 MT per day. The survey findings indicate that Nakuru County has the largest number of farmers (99 percent) growing Shangi (Table 3).

4.2 Identification and quantification of market segments

4.2.1 Market segmentation

Using Kotler et al. (2009) and Christall (1985) approaches of segmentation the ready-cut chips market produced four main segments based on the use and important features and attributes. The first segmentation was based on end use of the ready-cut chips and yielded two main segments; the **Commercial segment** representing buyers of ready-cut chips that prepare and sale french-fries and the **Home users segment** representing buyers of ready-cut chips that prepare French-fries for home consumption. Further segmentation of the Commercial segment yielded two sub-segments, namely **Franchise hotels** and **Local hotels**. The Local hotels were further sub-divided into **Classified hotels** and **Unclassified hotels** (**Error! Reference source not found.**).

Figure 4: Ready-cut chips market segments



4.2.2 Home users market segment

The study findings indicated that most home users (79 percent) considered thickness as an important feature of good ready-cut chips and medium size was the most preferred. Color was also cited as an important feature by 93 percent of this market outlet and majority preferred yellow color. The length of chips was also important to 86 percent of the market outlet and medium length was the most preferred (Table 14). Other attributes considered important by respondents were storability, taste, and brand

Table 14: Features and attributes preferred by home user segment

Features/ Attribute	Important for outlet (%) (n=14)	Preferred attribute (%)
Thickness	78.6	Medium (66.7), chunky (45.5)
Color	92.9	Yellow (76.9)
Length	85.7	Medium (66.7)
Crunchiness	90.7	Crunchy

Source: USAID-KAVES Potato survey, 2014

4.2.3 Commercial market segment

The survey categorized **franchise hotels, classified and unclassified hotels** as the main sub-markets under the commercial market segment (**Error! Reference source not found.**).

4.2.3-1. Franchise hotels sub-market

Hotels and restaurants under this category import directly or buy ready-cut frozen chips from importing agents. Use of imported frozen chips is to guarantee quality and standards set by the parent companies which include traceability. Kentucky Fried Chicken (KFC) and Tribe hotel fall in this segment. Since importation takes a while the hotels and restaurants in this sub-segment have well established procurement systems and requisite facilities such as cold rooms that make it easier for them to source, procure and store ready-cut frozen chips. The survey findings indicate that traceability is a distinct feature or attribute of chips in the franchise hotel sub-market. Subsequently, the sub-market only use imported ready-cut frozen chips (Table 15).

Table 15: Proportion of ready-cut chips sold in each segment

Market for ready-cut chips	Type of locally processed ready-cut chips		Type of Imported ready-cut chip	All types ready-cut chips
	Fresh	Frozen	frozen	
Ready-cut chips sold in home user and commercial market segment (%)				
Home user	4.4%	1.6%	2.3%	8.2%
Commercial	80.8%	0.0%	11.0%	91.8%
Percent of ready-cut chips sold in sub-markets of commercial market segment				
Franchise hotels	0.0%	0.0%	2.8%	2.8%
Classified hotels	19.4%	0.0%	8.2%	27.6%
Unclassified hotels	61.4%	0.0%	0.0%	61.4%
Ready-cut chips sold to home users and in sub-markets of commercial market segment (%)				
Home user	5.1%	100.0%	17.1%	8.2%
Franchise hotels	0.0%	0.0%	21.1%	2.8%
Classified hotels	22.8%	0.0%	61.8%	27.6%
Unclassified hotels	72.1%	0.0%	0.0%	61.4%

Source: USAID-KAVES Potato survey, 2014

The survey findings further indicate that freshness, crunchiness, and taste were not considered as important attributes in the franchise hotel sub-market. However, thickness, length and color are important attributes in franchise hotel sub-market. The study findings indicated that most franchise hotel (75 percent) considered length as an important feature of good ready-cut chips and medium size was the most preferred. Thickness was also cited as an important feature by 75 percent of this market outlet and majority preferred chunky thickness. The color of chips was also important to 67 percent of the market outlet and majority preferred whitish color (Table 16). Other attributes considered important were storability and brand.

Table 16: Features and attributes preferred in the commercial sub-segments

Features/ Attribute	Franchise hotels (n=4)	Classified hotels (n=8)	Unclassified hotels (n=23)	All (n=35)
Length (%)				
Medium	75.0	75.0	56.5	65.7
Long	25.0	25.0	43.5	34.3
Thickness (%)				
Chunky	75.0	37.5	38.1	42.4
Medium	0.0	25.0	28.6	24.2
Slim	25.0	37.5	33.3	33.3
Color (%)				
Whitish	66.7	40.0	41.2	44.0
Yellow	33.3	60.0	58.8	56.0

Source: USAID-KAVES Potato survey, 2014

The survey findings indicate that the franchise hotel sub-market use 69.6 MT per year of imported ready-cut frozen chips, representing 3 percent of the ready-cut chips sold in the commercial segment. The franchise hotel sub-market accounts for 26 percent of the ready-cut frozen chips passing through the commercial market segment (Table 17**Error! Reference source not found.**).

Table 17: Quantity of ready-cut chips supplied (MT/year)

Form of ready-cut chips	Franchise hotels	Classified hotels	Unclassified hotels	Total of commercial segments
Sampled hotels/ restaurants (mean)	(n=4)	(n=8)	(n= 23)	(n=35)
Fresh	0.0	30.2	25.9	23.9
Frozen	17.4	12.7	0.0	4.9
All hotels and restaurants (total)	(N=4)	(N=16)	(N= 59)	(N=79)
Fresh	0.0	482.9	1,526.2	2,009.1
Imported frozen	69.6	203.5	0.0	273.1
Total	69.6	686.4	1,526.2	2,282.2

Source: USAID-KAVES Potato survey, 2014

4.2.3-2 classified hotels

This sub-market segment is represented by 3 to 5 Star hotels and restaurants. A part from traceability of potato, the sub-market segment observes strict quality and standards requirements. In view of this, classified hotels and restaurants import ready-cut frozen chips with preferred features and attributes when there is local shortage in supply of ready-cut fresh chips. The survey findings indicate that classified hotels and restaurants do not use locally processed ready-cut frozen chips out of the need for maintaining high quality chips *(*Table *15).*

The study findings indicated that most hotel and restaurants under this sub-market segment (75 percent) considered length as an important feature of good ready-cut chips and medium size was the most preferred. The color of chips was also important to 6o percent of the market outlet and majority preferred yellowish color. However, less than 50 percent of the respondents considered thickness as an important attribute (Table 16). Other attributes considered important were storability and brand.

The sub-market segment procure a total of 686.4 MT of ready-cut chips per year; 482.9 MT of ready-cut fresh chips and 203.5 MT of ready-cut imported frozen chips. The sub-market segment account for 30 percent of the ready-cut fresh chips and 75 percent of the ready-cut frozen chips procure by commercial market segments *(*Table 17).

4.2.3-3 unclassified hotels

This sub-market segment comprises of unclassified hotels and restaurants. The sub-market segment applies minimum quality and standard requirements compared to the other sub-market segments aforementioned. The survey findings indicate that unclassified hotels only use locally processed ready-cut fresh chips partly because of affordability (Table 15). Tasted was considered an important attribute under this category.

The study findings indicated that 57 percent of the respondents under this category considered length as an important feature of good ready-cut fresh chips and medium size was the most preferred. However, less than 50 percent of the respondents considered color and thickness as an important attribute (Table 16). There is no storage of ready-cut chips in this category.

This sub-market segment accounted for a total of 1,526.2 MT per year representing 67 percent of ready-cut fresh chips sold in commercial market segment (Table 17).

4.3 Effect of features and attributes on prices

The Home user segment was not concerned with traceability aspect nor was it particular with the potato variety used but only bought imported read-cut frozen chips when there was no locally processed available. The price of ready-cut frozen chips averaged KESs 70.0/kg. For the Franchise hotels sub-segment the requirement for traceability and designated potato variety forced them to buy imported ready-cut frozen chips whose price was 60 percent more than (KES 240 /kg) that of locally processed ready-cut frozen chips (KES 150 /kg).

4.4 Distribution channels for Ready-cut chips

4.4.1 Distribution channel for Ready-cut fresh chips

The distribution channel for potatoes for processing into ready-cut fresh chips starts from farmers at county levels. The farmer supplies potatoes either directly or indirectly to the processor, through a broker to the wholesaler who then supplies to the processor or a supply agent contracted by the processor.

Most ready-cut fresh chips processors are based in Nairobi and mainly use Shangi variety sourced from the major potato markets in Nairobi. A few processors however, source directly from potato growing areas that are near Nairobi. The processed ready-cut fresh chips are supplied on order to users in Home user and Commercial segments by the processors themselves or through distributing agents (**Error! eference source not found.**).

4.4.2 Distribution channel for locally processed Ready-cut frozen chips

The locally processed ready-cut frozen chips are mainly processed from Tigoni variety, which is suitable for freezing and is bought from the local markets or contracted farmers. Processed ready-cut frozen chips are supplied on order to supermarkets and upmarket groceries in Home user segment either directly by the processor or through a distributor agent. The ready-cut frozen chips stocked by the supermarkets and groceries are bought by home users only.

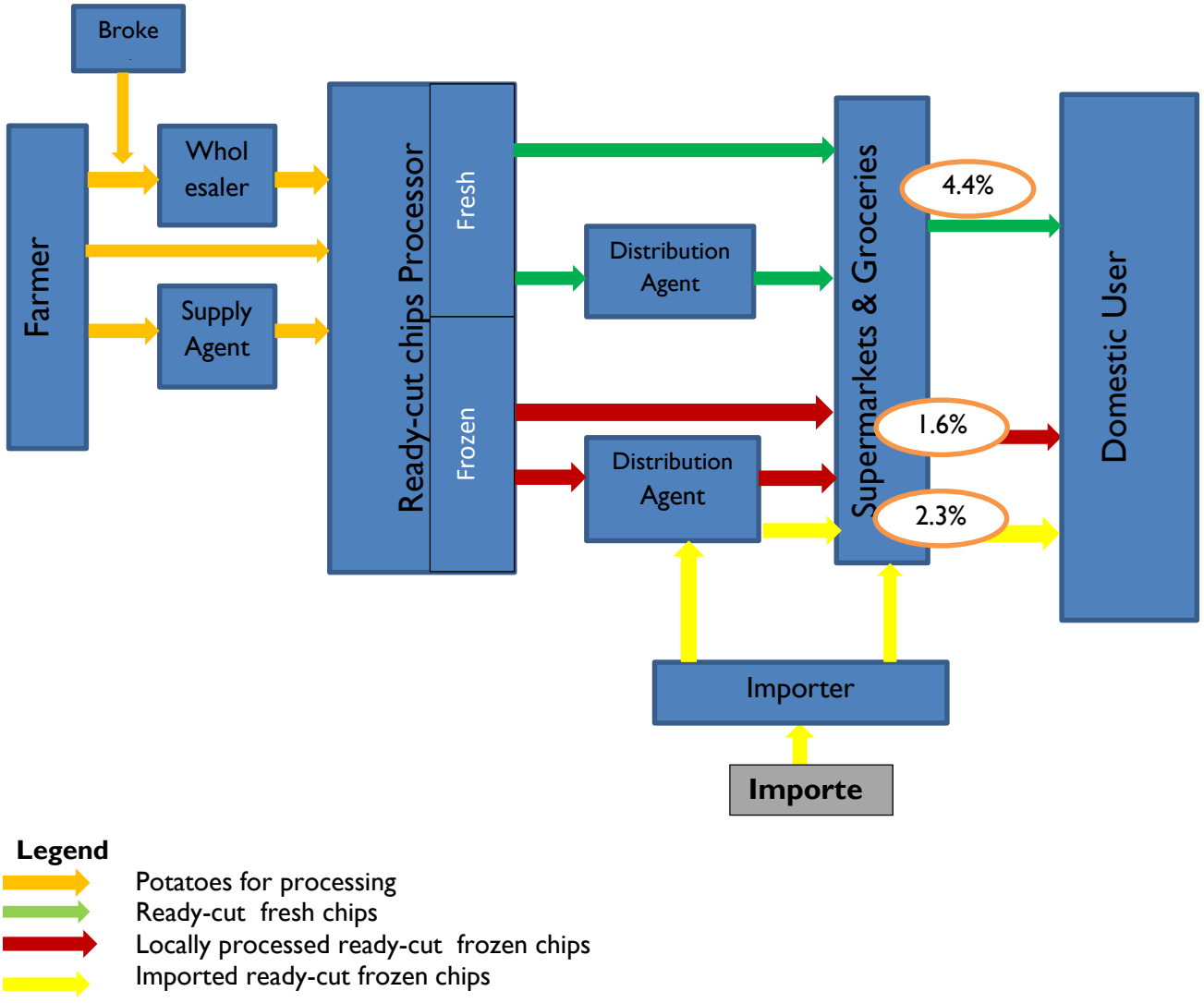
4.4.3 Distribution channel for imported Ready-cut frozen chips

Imported ready-cut frozen chips are either imported directly by some hotels and restaurants or by an importer who sell them to hotels, restaurants and supermarket or sells to distribution agents.

4.4.4. Distribution channels in the Home users market segment

The Home user segment comprises of the three channels, for ready-cut fresh chips, imported ready-cut frozen chips and locally processed ready-cut frozen chips. The distribution channels in the Home user segment consist of processor, supply agent, market outlet (supermarket, up-market groceries) then to home users. The market outlets are supplied either directly by the processor or supply agents, after which the home users obtains the ready-cut chips from the market outlet (Error! Reference source not ound.**).**The read-cut frozen chips produced by local processors are either sold directly or through distribution agents to supermarkets and groceries. The supermarkets and groceries either directly import the ready-cut frozen chips or buy from the importing supply agents.

Figure 5: Distribution channels in the domestic user segment

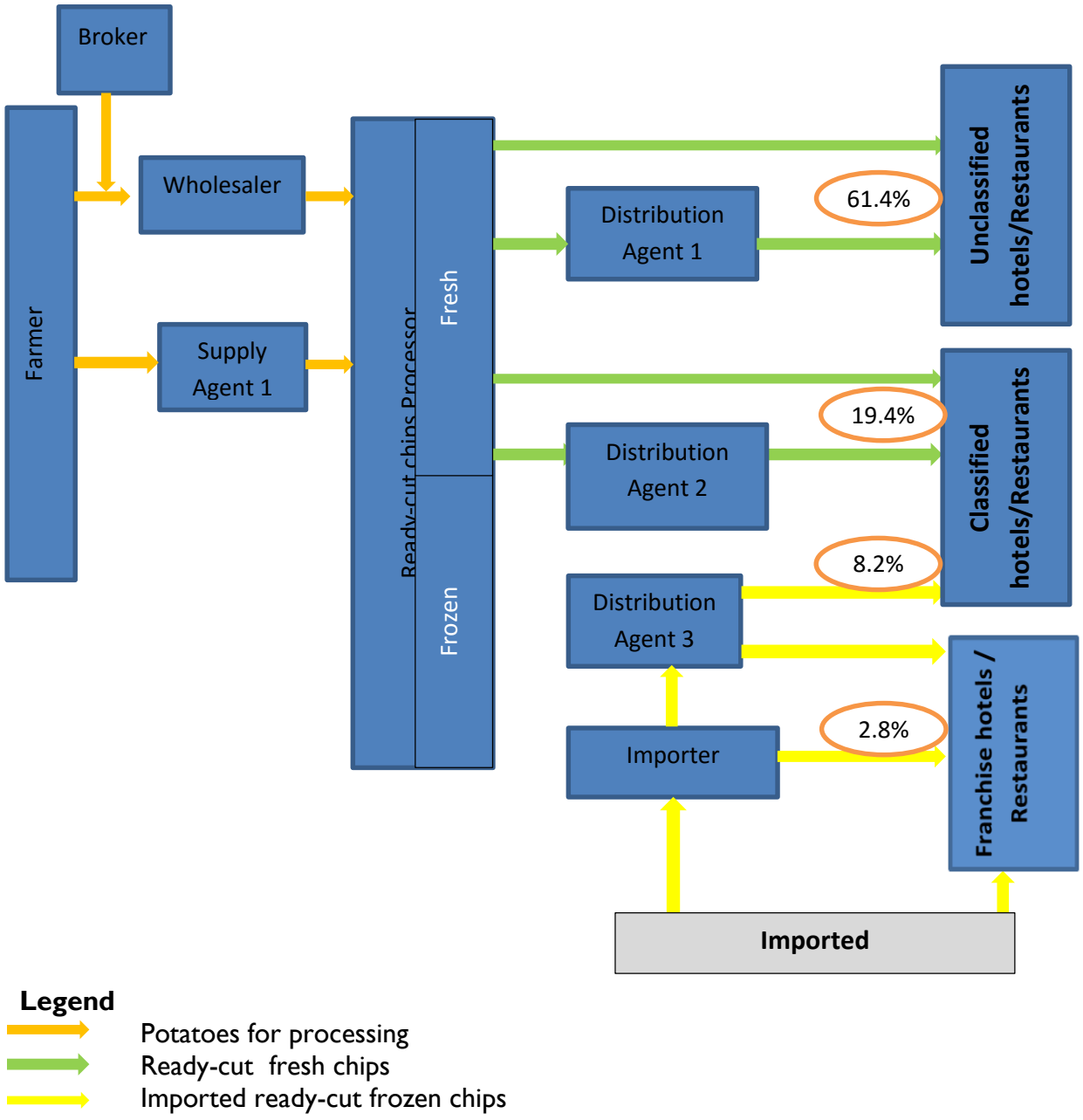


4.4.5 Distribution channels in the commercial market segments

The commercial segment comprises of two channels, Ready-cut fresh chips and imported ready-cut frozen chips. For Ready-cut fresh ships potatoes are supplied to a processor either directly by the farmers or by supply agents (
). After processing, the processor sells ready-cut fresh chips to distribution agents or sells directly to local hotels and restaurants in Unclassified and Classified hotels sub-segments.

The imported ready-cut frozen chips used in the commercial segment are either imported directly by hotels and restaurants in Franchise hotel sub-segment or imported by distribution agents who then sell them to hotels and restaurants in classified hotel and Franchise hotel segments.

Figure 6: Distribution channels in the commercial segments



4.4.6 Actors in the domestic and commercial distribution channels

Farmer: Farmer is the initial source of potato for ready-cut chips processing and either sells directly to processor or to a wholesaler through a local broker or a contracted supply agent.

Broker: Sources potatoes for the wholesaler from different farmers and is useful in the bulking processed and helps in identifying which farmer has suitable potatoes ready for sale.

Wholesaler: Buys large quantities either directly from the farmer or is supplied to by a broker then resells to ready-cut chips processor

Supply agent: Acts as intermediary between the farmer and the ready-cut chips processor, usually contracted by the processor to supply potatoes for processing into ready-cut chips.

Ready-cut chips processor: Procures potatoes and processes into ready-cut chips (either frozen or fresh).

Distribution agent 1: Source for fresh ready-cut chips from processors on behalf of market outlets, usually contracted by market outlets.

Distribution agent 2: Sources for both locally processed and imported ready-cut frozen chips on behalf of the market outlets, also contracted by market outlets.

Distribution agent 3: Sources for imported ready-cut frozen chips only on behalf of the hotels, restaurants and institutions that require ready-cut chips frozen that use this forms of ready-cut chips, usually on contract by market outlets.

Importer: Imports ready-cut frozen chips into the country then either distributes directly to market outlets or to distribution agents contracted by market outlets.

Market outlet: Stocks fresh, locally processed frozen and imported ready-cut frozen chips then sells to domestic user.

Domestic user: Buys ready-cut fresh chips or ready-cut frozen chips from market outlets or upmarket groceries for cooking and eating at home.

Commercial user: Purchases ready-cut chips in either fresh or frozen state from distribution agents, processors and importers for cooking and reselling as chips to consumers.

4.5 Competitiveness

The survey findings indicated that there were eight active ready-cut fresh chips processors and none of them dominated the market. The ready-cut frozen chips segment had one dominant player which has operated below its capacity for many years and was not processing read-cut frozen chips during the year of interview (2014). This has created a gap which if not filled through entrants by new processors it will necessitate increased importation.

The ready-cut frozen chips constituted 15 percent of the total ready-cut chips in the market while imported ready-cut frozen chips constituted 13 percent of the total ready-cut frozen chips in the market outlets. This shows the enormous potential of substituting the imported frozen

chips with local frozen or fresh ready-cut chips. There was hardly any brand loyalty in the ready-cut chips markets, except for imported ready-cut frozen chips.

Farmers supplying potato for processing potatoes into fresh and frozen ready-cut chips are smallholders who are fragmented and have very little bargaining power. They hardly have any possibility for forward integration and hence the processor has more clout in determining the pricing of the raw material.

The locally processed ready-cut chips are characterized by low quality due to inadequate processing varieties, as opposed to the imported ready-cut chips which is of superior quality. Lack of suitable varieties for production of ready-cut frozen chips pose a big challenge to the existing processors and potential entrants. However, the ready cut-fresh chips industry is still in its infancy and even new entrants will still have a large market to fill up.

The industry can therefore be said to be less competitive and has potential for rapid growth and expansion.

4.6 Demand and supply

4.6.1 Supply of Potatoes for processing into ready-cut chips

The conversion ratios of potato to ready-cut chips for processors supplying home user, classified and unclassified hotels sub-market segments were derived under this study from a survey conducted among processors. The International Standard Conversions Ratio of potato to ready-cut chips was adopted for processors supplying franchise hotel sub-market segment (*Table 18*).

Using the aforementioned conversion ratios and quantities of ready cut chips supplied to home user sub-market segment and to franchise hotels, classified hotels, and unclassified hotels quantities of potato used to process ready-cut chips supplied in the four submarket segments was calculated (Table 18). Previous study (Kaguongo et. al. 2014) indicates that 5 percent of total potato produced goes into preparing French fries. With a total production of 2.9 million MT of potato in 2014, this survey calculated volume of potato prepared into French fries in that year to be 145,000 MT. Using the figure of potato (3,512.5MT) processed into ready-cut chips in 2014 (Table 18) as a fraction of the total volume of potato prepared into French fries, the survey determined that 2 percent of total potato produced was used in preparing ready-cut chips in 2014.

Table 18: Potato supplied in various market segments in 2014 (MT/ year)

Form of ready-cut chips	Home users	Franchise hotels	Classified hotels	Unclassified hotels	Total
Ready-cut chips (MT)	204.0	69.6	686.4	1,526.20	2,486.20
Conversion ratio	85.0%**	90.0%*	80.0%**	65.3%**	70.8%
Potatoes for processing into ready-cut chips (MT)	240.0	77.3	858.0	2,337.2	3,512.5

Source: USAID-KAVES Potato survey, 2014

*Potato: ready-cut chips international standard conversions ratio

** Potato: ready-cut chips conversions ratio determined from the survey

4.6.2 Growth of the ready-cut chips market in last 10 years

The demand for ready-cut fresh and frozen chips is mainly affected by the growth of fast food restaurants, hotels, supermarkets and domestic users. The rapid growth of fast foods restaurants in Kenya for the past decade as well as the growth of urban population (KNBS, 2014) have contributed to growth in demand of ready-cut fresh and frozen chips. The change in government structure is also accelerating the growth of towns and cities in the counties which is increasing urbanization hence increasing demand for processed potato products.

Beside two large commercially registered ready-cut chips processors the many newly formed small enterprises dealing with ready-cut chips are expected to transform into medium and fully-fledged processing companies dealing with ready –cut fresh and frozen chips in near future. Many of the small enterprises recently started emerged since 2011 and this could partly explain the temporally decline of the imported ready-cut frozen chips in 2013. The quantity of the ready-cut fresh chips in the market has grown at an annual growth rate of 10 percent since 2004, increasing from 799.1 MT in 2004 to 2,117.8 in 2014 (

Table ***19***). Njoro Canners Limited was the sole local supplier of ready-cut frozen chips between 2001 and 2013. The company supplied an average of 1140 MT of ready-cut frozen chips per year during that period.

In 2013, a total of 1,226.9 MT of ready-cut frozen chips was marketed in the country, of which 132.3 MT was imported and 1,094.6 was locally processed (

Table ***19***). In 2014 the major processor did not produce ready-cut frozen chips mainly due to lack of potatoes for processing. However, the new entrant produced 38.9 MT of ready-cut frozen chips while the imported ready-cut frozen chips was 329.5 MT. The shortfall of 858.5 MT from 1,226.9 in 2014 is likely to have been met by the growing ready-cut fresh chips market segment that is having new entrants every year.

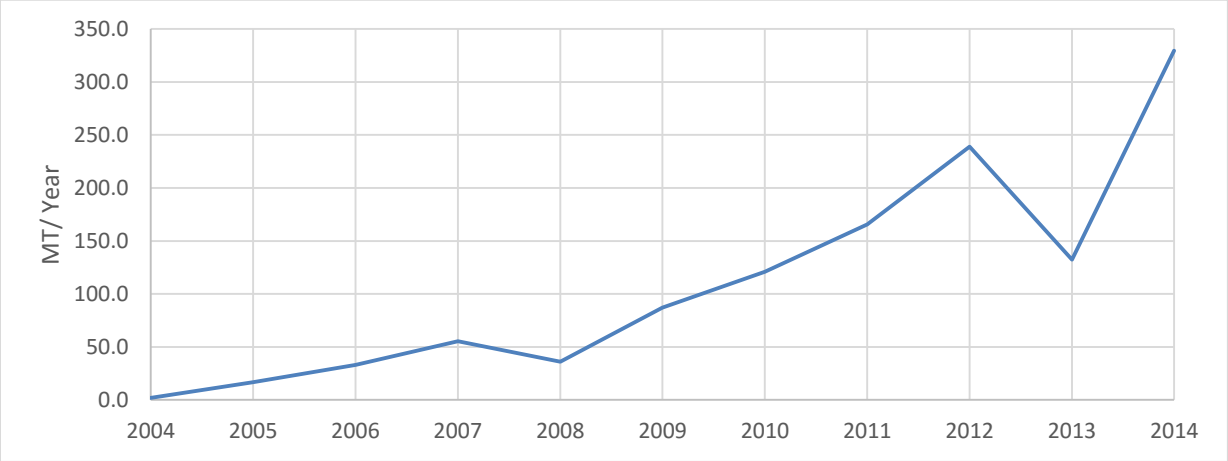
Table 19: Quantity of Ready-cut fresh and frozen chips marketed in past 10 years

Year	Ready-cut frozen chips				Ready-cut Fresh (MT)	Total ready-cut fresh and frozen quantity (MT)
	Import (MT)	Locally processed (MT)	Locally processed less Exports (MT)	Total ready-cut frozen		
2004	2.0	1,140.0	1,129.8	1,131.9	799.1	1,930.9
2005	16.8	1,140.0	1,118.9	1,135.7	799.1	1,934.7
2006	33.0	1,140.0	1,054.6	1,087.7	799.1	1,886.7
2007	55.5	1,140.0	1,051.4	1,106.9	799.1	1,906.0
2008	36.0	1,140.0	1,068.6	1,104.6	799.1	1,903.7
2009	87.0	1,140.0	934.0	1,021.0	1,321.3	2,342.3
2010	120.8	1,140.0	1,098.0	1,218.8	1,321.3	2,540.2
2011	165.6	1,140.0	1,122.6	1,288.3	1,355.3	2,643.5
2012	238.9	1,140.0	992.0	1,231.0	1,583.8	2,814.8
2013	132.3	1,140.0	1,094.6	1,226.9	2,104.7	3,331.7
2014	329.5	38.9	38.9	368.4	2,117.8	2,486.2

Sources: Export Promotion Council (ECP) and USAID-KAVES Potato survey, 2014

The quantity of ready cut-frozen chips imported has been increasing steadily at a rate of 67 percent since 2004 with an accelerated increase in 2010 (**Error! Reference source not ound.**). Incidentally, the period since 2010 is when most multinational fast food restaurants were established in Kenya. The need to import ready-cut frozen chips stems from two major limitations in the market; the fact that there are two major seasons for potato production per year hence the need to import in order to even out supply throughout the year. The quality of marketed potato does not meet the required standards of emerging upmarket franchised hotels and restaurants hence the gap is being filled mainly by importation of ready-cut frozen chips from countries such as Egypt, South Africa and Europe.

Figure 7 : Frozen potato imports (2003-2014).



Source: EPC Report, 2014 and Survey data

4.6.3 Projection of future demand for potatoes for processing into ready-cut chips

The quantity of imported ready-cut frozen chips in the market in the next 10 years was projected using annual growth rate of 67 percent while exportation was assumed to be zero until the locally processed ready-cut frozen chips exceeds the 1,226.9 MT of locally processed ready-cut frozen chips marketed in the country in 2013 before the major company exporting ready-cut frozen chips stopped processing ready-cut frozen chips. Assuming the new entrant companies will take over the market share previously held by the locally processed ready-cut frozen chips in 5 years the production is expected to increase at a rate of 97 percent per year. The imported ready-cut frozen chips was expected to continue growing at a rate of 66.5 reaching 4,218.8 MT per year in 2019 and 54,015.0 MT per year in 2024 (

Table **20**).

An overall annual growth of 65 percent shows that 55,155.0 MT of ready-cut frozen chips will be utilized in 2024 (

Table **20**) indicating a demand of approximately 77,902.5 MT of potatoes for processing into ready- cut frozen chips. Annual growth rate of 10 percent of ready-cut fresh chips would mean 5,593.7 MT of ready cut-fresh chips will be sold in the market in 2024, indicating a further demand for potatoes for processing into ready-cut fresh chips of 7,900.7. This results to a total demand of 85,803.2 MT of potatoes for processing into all forms of ready-cut fresh and frozen chips in 2024. This means if the current challenges, such as inadequate supply of suitable processing varieties and traceability, are not addressed and the annual growth rate of ready-cut fresh chips continue at 10 percent the Kenya will have to import 54,015.0 MT of ready-cut frozen chips, worth over USD 129.6 million in 2024.

Table 20: Summary of projected quantities of ready-cut chips

Year	Quantity Imported (MT)	Quantity processed by new entrants total) (MT)	Ready-cut fresh chips	Projected total quantity (MT)
2014	329.5	38.9	2,117.8	2,486.2
2015	548.7	76.4	2,333.8	2,958.9
2016	913.7	150.2	2,571.9	3,635.8
2017	1,521.4	295.2	2,834.2	4,650.8
2018	2,533.5	580.1	3,123.3	6,236.9
2019	4,218.8	1,140.0	3,441.9	8,800.6
2020	7,025.1	1,140.0	3,792.9	11,958.0
2021	11,698.1	1,140.0	4,179.8	17,018.0
2022	19,479.7	1,140.0	4,606.1	25,225.9
2023	32,437.6	1,140.0	5,076.0	38,653.6
2024	54,015.0	1,140.0	5,593.7	60,748.8

Source: USAID-KAVES Potato survey, 2014

4.7 Market segments with the greatest opportunity for development

4.7.1 Opportunities for Ready-cut frozen chips processing in Kenya

Only 10 percent of potato produced is processed indicating there is room to grow processing especially to meet the increasing demand for processed ready-cut frozen chips. The increasing amount of imported potato products in upmarket supermarkets, shopping malls and multinational fast food restaurants, points to great opportunities for local processing companies to produce ready-cut frozen chips and farmers to produce and sell potatoes for processing into chips. The increasing presence of multinational fast food restaurants, the opportunity for processing ready-cut frozen chips will be high as these entities prefer ready-cut frozen chips of the quality and standard set by parent companies.

However, due to the preference by the Kenyan population for fresh rather than frozen chips greater opportunity lays in processing ready-cut fresh potato chips which is currently 85 percent. Of the total ready-cut chips in the market. This would give an edge to the locally based processors due to challenges of importing ready-cut fresh non-frozen potato chips.

With Kenya being recently classified as middle income economy and the continued development of towns and cities in the Counties it is expected that middle income group will continue to rise, which will lead to increase per capita consumption of ready-cut fresh and frozen chips

As the economy grows and becomes sophisticated there is opportunity for the current cottage level production of ready-cut chips to transform into medium and fully-fledged companies supplying both ready-cut fresh and frozen chips.

4.8 Appropriate marketing strategies for ready cut potato chips

Traceability: The need to trace a product's movement from its source and through the supply chain, its history and location by use of documentation is fast becoming important for the economies that are consciences of the health of the citizens. There is need for the potato industry

to adopt traceability system in order to improve the quality of the potatoes and potato products in the market. This will also enable the locally processed ready-cut frozen chips be accepted in the upmarket outlets that import ready-cut frozen chips because of lack of traceability in Kenya.

Variety development: Currently, Tigoni is the most suitable variety for processing into ready-cut frozen chips among the available varieties. However, more farmers are moving to growing Shangi variety which is high yielding and preferred by alternative market. This has led to abandoning of Tigoni causing a shortage. It is therefore important that the development of and introduction of new better yielding varieties that are suitable for frozen chips be hastened. Most processors use the Shangi variety in processing ready-cut fresh chips. However, the major challenge affecting Shangi in ready-cut chips processing is its short dormancy and deep eyes leading to difficulties in storage and high losses during processing.

Contract farming: There is also need to create some partnership between farmers and processor in order for farmers to grow potatoes specifically for ready-cut frozen chips market. This could be achieved through promoting contract farming by addressing challenges in legal framework of contract farming and linking farmers to processors.

Farmer practice improvement: There is need to improve the quality of supplied potatoes through use of appropriate harvesting technics, sorting and grading. This will help reduce losses and wastes hence improve farm gate prices while at the same time it will help reduce cost of potato processing.

Health Aspects: Chips consumption has been associated with increase in obesity especially if poorly prepared with too much frying in oil. It is therefore important for processors, hotels and restaurants to adopt alternative methods of cooking such as oven baking.

5. Key stakeholders

5.1 Stakeholders in Crisps and Ready-cut frozen Chips processing

5.1.1 Main actors in the channels

Farmers

There are about 800,000 potato farmers. Farmer usually look for high yielding varieties that are popular in the fresh markets and do not mind if they are from research institutions or from other farmers or markets. Their production does not target any specific use of the potatoes leading to shortage of potatoes for specialized utilization such as for processing. Although there is Farmers organization, Kenya National Potato Farmers Association (KENAPOFA), that should organize production and lobby for better services for the members, they are not well organized.

Local Brokers

Local brokers identify farmers with produce ready for sale and link them up with local traders. Brokers work in groups and each group can deal with 30 to 70 farmers (Kaguongo et al., 2014). Brokers do not take ownership of the produce but are paid a commission per bag by the local traders. They are involved in packaging of potato bags according to the needs of respective potato traders.

Wholesalers

The wholesalers use their own trucks or hire transportation for ferrying produce to wholesale outlets. They commonly rely on market brokers to locate buyers for them in transshipment and terminal markets such as Nakuru, Nairobi and Mombasa. Others deliver directly to processors, wholesale storeowners, or to institutions. The most common channel is through market brokers.

Market-level Brokers

In most wholesale markets no trader is allowed to sell his produce without the assistance of the Brokers who have established relationships with clients. They mainly sell in wholesale and are paid on commission regardless of whether the trader makes profit or not. Their key competencies are that they have wealth of information in terms of produce seasonality, buyers and suppliers. Brokers have full understanding of dynamics of demand and supply in the markets of which they take advantage to manipulate prices. When prices go down due to oversupply in the markets, they communicate to those who supply to the markets to withhold supply sometimes creating artificial deficit.

They also offer produce on credit especially to the retailers who operate in the markets.

Retailers

These are sellers who directly interact with consumers. Retailers often pool their financial resources to purchase a bag of potatoes, which they divide among themselves. They retail whenever they can find space, along streets or within grocery markets in close proximity to residential areas. They usually sell in heaps and tins, although in some up-market locations, they

sell in potatoes in kilograms. Retailers are taxed per person to operate in most fresh produce wholesale markets although in principle the local authorities forbid this practice.

Supermarkets

Supermarkets in Kenya come in various sizes: some are quite small and individually owned whereas others are national or multinational retail chains. The large supermarket chains like Nakumatt, Uchumi and Tuskys are expanding with branches in all of Kenya's larger cities. The average quantity of potatoes sold per week in each supermarket branch is estimated at 120 kg (Kaguongo et al., 2014). Supermarkets are not a popular source of fresh potatoes because consumers prefer to buy from open-air markets where they are cheaper and fresher. Supermarkets' share of fresh potato sales is estimated at just 1 per cent.

Contracted traders supply the large supermarket chains with fresh potatoes on a weekly basis. The potatoes are brought to the central distribution center of a super market for onward distribution to branches nationwide. Supermarkets handle their own transportation to branches, using crates and refrigerated trucks to prevent any losses during transport. Supermarkets buy graded potatoes and will buy-in big tubers and baby potatoes according to consumer demand.

The potatoes are supplied already sorted and any defective potatoes found in the consignment delivered are returned to the supplier – this includes green, damaged or rotten tubers. However, returns are minimal as it is expected that the supplies will meet the standards laid down by the supermarket management.

Supermarkets are the only buyer at the retail level that rewards quality supply. Supermarkets do not experience seasonal fluctuations because supply and demand is almost constant.

Supermarkets also stock processed potato products crisps being the most dominant. Most of the crisps are locally produced although imported crisps are also common. Supermarkets also stock ready cut-frozen chips most of which is imported while the most dominant local brand is Njoro caning's golden valley. Few supermarkets stock ready-cut chilled chips. This may be because of their perishable nature.

Crisps processors

The large scale crisps processing include NORDA, Deepa Industries, and Propack. They have large capacity crisps processing lines and produce high quality crisps that meet international standards. The companies mainly use Dutch Robjin variety, mostly from Bomet, but are also exploring other areas, such as Narok and Meru, where there is irrigation to ensure supply of potatoes throughout the year. The companies are mainly engaged in snack foods and process a wide range of products from potatoes and maize.

Ready-cut fresh and frozen chips factories

Njoro Canning Company and Midlands company ltd are the two major factories producing ready-cut chips in the country which are based in Nakuru County and Nyandarua County respectively. The Njoro Canning started producing frozen chips in 2001 while Midland Company started in 2012.

The ready-cut frozen chips factories are faced with problems that include: (i) lack of varieties that are suitable for making frozen chips and (ii) competition from superior imported high quality frozen chips.

Ready-cut fresh chips processors

Ready-cut fresh chips processing is dominated by medium and small scale that include Panagro limited, Sereni fries limited, Mana foods suppliers limited and Supa Gaea foods limited. These processors supply ready-cut chips to hotels and restaurants in major urban areas. The companies produce a range of fresh potato products i.e. chips, cubes and whole peeled potato. They mainly operate in small premises using knives to peel potatoes and simple machines to cut potatoes into chips.

Hotels and Restaurants

Hotels and Restaurants are major outlets for the potatoes consumed in Kenya's main urban centers. Many of them specialize in chips, a popular dish with the urban population, especially young people.

Hotels are classified into either five star, four star three star or standard. The five star hotels tend to mostly use ready cut fresh and/or frozen chips while the standard hotels mainly process their own chips within their premises. Most restaurants process their own chips with some having washing peeling and cutting machines .Majority however prepare them by hand peeling and hand operated cutting machines. Some of the International chain fast food restaurants however utilize ready-cut frozen chips imported from Egypt and/or South Africa. They also use ready-cut fresh chips from processors like midlands and panagro.

5.1.2 Development service providers

The Ministry of Agriculture, Livestock and Fisheries (MoALF): State Department of Agriculture and County Government

The Ministry aims at revitalizing the Kenyan potato sector and is responsible for implementation of the Agricultural Sector Development Strategy 2010-2020, the National Root and Tuber Crops Policy (2010), Seed Potato Strategy (2009) and the Seed Potato Sub-Sector Master Plan 2009 - 2014, as well as legal notices addressing the packaging of seed and ware potatoes. The Government published in 2012 the National Agricultural Sector Extension Policy to improve the extension system. It provides extension services.

After devolution the role of extension in MoALF was devolved to County government while the state department of agriculture is mainly responsible for policy and regulations.

Agricultural, Fisheries and Food Authority (AFFA)

AFFA is a government agency in charge of regulations and standards for crops and fisheries. The Directorate of Food Crops under AFFA is in charge regulations and standards for potatoes and other food crops such as maize, wheat and sweet potatoes.

Kenya Industrial Research and Development Institute (KIRDI)

The processing value chain is regulated by KIRDI. It is a national research institute under the Ministry industrialization and enterprise development and mandated to undertake multidisciplinary research and development in industrial and related technologies. The mandate includes reducing post-harvest food losses through development, adoption, adaptation and transfer of appropriate food processing and storage technologies; specific activities or projects for the potato processing industry are not known.

Kenya National Potato Research Centre, Tigoni (Kenya Agriculture and Livestock Research Organization [KALRO] former KARI

KALRO Tigoni is national research Centre mandated to conduct research on potatoes. It is a sub center of KALRO. It is responsible for breeding and production of basic seed potato for the country.

International Potato Centre (CIP)

CIP headquarters is in Peru with a regional office in Nairobi. CIP is an international research institute that is part of the Consultative Group on International Agricultural Research (CGIAR). It is responsible for global potato germplasm and develops and disseminates new and improved clones, varieties and technologies aimed at improving yields, nutrition and market access. Over the years CIP has provided technological research backstopping for the seed potato industry in the country. CIP does this through research and innovation in science, technology, and capacity strengthening. It promotes the use of tissue culture facilities and hydroponic/aeroponics units for the production of mini-tubers in an attempt to make countries self-sufficient in seed supply.

Kenya Plant Health Services (KEPHIS)

Kenya Plant Health Services is a regulatory agency mandated to do quality assurance on agricultural inputs and produce in Kenya. KEPHIS undertakes plant variety protection; seed certification; phytosanitary inspection of imports and exports and analysis of soil, water, agricultural produce, fertilizers and pesticides. KEPHIS is a government institution with the mandate for both quarantine issues as well as seed certification. KEPHIS is also responsible for providing import permits for seed potatoes and performing import inspections

Agricultural Development Corporation (ADC)

ADC is a provider of quality seed to the Kenyan farmers, ADC, a parastatal institution, is a main seed grower in Kenya. Currently it has some 80 ha under certified seed potatoes, but this area is projected to increase to almost 300 ha. (NPCK data) The corporation's long-term goal is to cultivate 1,200 ha of certified seed potatoes. ADC is in the process of building up its capacity for basic seed production by putting up glasshouses and aeroponics units. Major weakness of ADC is a missing distribution system for certified seeds produced – farmers seeking seed potatoes must travel to Molo, some as far away as 500 km.

5.1.3 Private sector players

National Potato Council of Kenya

The NPCK is a Public-Private Partnership organization which was formed as a result of a transformation of the potato value chain development committee. It is constituted by members from private institutions (KENAPOFA, Seed producers, Traders, Processors, Financial institutions etc.) and public institutions (MoALF, County Government, KEPHIS, KALRO, ADC, etc.). The NPCK provides coordination, linkages and information support between the various actors and players in the potato industry. It provides platform for stakeholders to engage and address sub-sector issues as well as planning for development. It is charged with the responsibility of transforming the sub-sector into a robust, competitive and self-regulating industry with a commercial orientation

Kenya National Farmers Federation (KENAFF)

KENAFF is the umbrella body of farmers' institutions in the country, bringing together 60 farmers' associations at county level, 36 national commodity-based associations, and 16 cooperatives and close to 8,000 farmers' groups. Since the federation started focusing on group based institutional members, the membership has grown to include commodity associations such as Kenyan National Potato Farmers Association.

Kenya National Potato Farmers Association (KENAPOFA)

KENOPOFA operates under the umbrella of KENAFF and is also engaged in implementing standard packaging; the association was founded in 2003; with a membership of 10,400 farmers growing 3,350 hectares of potato. KENAPOFA offices are based at KALRO-Kabete, with a coordinator under the supervision of the NPCK and KENAFF.

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ANNEXES

Annex 1: Potato varieties

	VARIETY NAME	YR OF RELEASE	OPTIMUM ALTITUDE	*MATURITY (MONTHS)*	*YIELD (T/HA)*
1	TIGONI	1998	1800-2300m	3-4	30-35
2	KERR'S PINK	1960's	1400-2700	2-3	25-30
3	DUTCH ROBJIN	1960's	1600-2600	4-5	35-40
4	KENYA MPYA	2010	1400 - 3000	3- 3.5	35 - 40
5	KENYA FAULU				
6	SHANGI	N.R			
7	ASANTE				
8	KENYA SHEREKEA	2010	1800 - 3000	3.5 - 4	40 - 50
9	PURPLE GOLD	2010	1800-3000	4 -4.5	20 - 35
10	KENYA MAVUNO				
11	KENYA KARIBU				
12	KENYA SIFA				
13	DESIREE	1972	1800- 2600	4 -4.8	35-40
14	KENYA BARAKA	1973	1600 - 2300	2.6 - 4	30 - 35
15	ANNET	1972	1400-2400	2.5 – 3	30 -35
18	TOLUCA			120 days	25-32
19	MAYAN GOLD			120 days	20-30
20	CARUSO			90-100 days	25-35
21	SAGITTA			120 days	70-75
22	DERBY			100 days	70-75
23	AMBITION			150 days	70-75
24	SARPO MIRA			4	45
25	MANITOU			4	45
26	SAVIOLA			4	42.5
27	MUSICA			4(120 days)	60
28	ROYAL			4	60-80
29	JELLY			5(165 days)	55
30	EL MUNDO			Medium to late	80
31	FALUKA			3.5-4	42.5
32	SARPO MIRA			4	45
33	MANITOU			4	45

Annex2: List of potato Processing Companies

	COMPANY	PRODUCTS	TELEPHONE
1	Candz Ltd	Crisps	551901
2	Top snacks	Crisps	none
3	Pioneer foods	crisps	none
4	Chirag	Crips	254 20557898/650777
5	Deepa industries	Crisps. Chevda	3573000-3
6	Norda Industries	Crisps	0202367881
7	Propack	Crisps	020 8561185
8	Njoro canning	Frozen chips, dehydrated potatoes	
9	Kellmwanz	Crisps	0726 671362
10	Kristas ltd	Crisps	020-3003587/
11	Happy eater ltd	Crisps	none
12	Leakims eater ltd.	Crisps	722262894
13	Deluxe foods	Crisps	550790
14	Super snack	Crisps	558758
15	Salma industries	Crisps	6766730
16	Penny foods	Crisps	722875559
17	Wheatbee	Crips	735587354
18	Three star packers	Crisps	721531877
19	Kismart enterprises	Crisps	723347648
20	French products (k) ltd	Chips	none
22	Midlands	Ready chips	
23	Bright Bonika foods ltd	Crisps	0722-309648
24	Kenroid ltd	Crisps	
25	One stop enterprises	Piripiri	3746768
26	Vina enterprises	Vina salted crisps	
27	Magic time	Crisps	
28	Sunseed	Crisps	
29	Super quality snacks	Crisps	0733-903882
30	Kimme food products	Crisps	721774148
31	Kara smart food prod.	Crisps	
32	Quince foods	Crisps	
33	Lybo bites	Crisps	
34	BBJK Food prod.	Crisps	0720274275
35	Sunace foods	Crisps	0713316594
38	Viva snacks	Crisps	0733903086
39	Raani foods	Crisps	0728202954
40	Rimusa prod.	Crisps	0725535533
41	Saima	Crisps	
42	Njambini foods	Crisps	0721123330

	COMPANY	PRODUCTS	TELEPHONE
43	Green point grocers	Peeled Potatoes	0724395990